

The Biologist



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May, 1946

Phi Sigma

BIOLOGICAL HONOR SOCIETY

"The object of Phi Sigma is to promote interest in biological research. Although originally designated as an honorary biological research society, it should not be considered as a working guild of biologists interested in research. In effect, election to Phi Sigma should be an opportunity for better work, rather than merely election to an honorary society."

Mile Posts:

- 1915 March 17, Alpha Chapter organized, Ohio State University, Columbus.
- 1916 May, Central Governing Body organized, BIOLOGIST first issued.
- 1917 June, last War-time BIOLOGIST issued.
- 1921 February, BIOLOGIST revived.
- 1924 December, First National Meeting, Constitution revised, Washington, D.C.
- 1925 December, Second National Meeting, First Science Program, Kansas City.
- 1926 December, Third National Meeting, Second Science Program, Philadelphia.
- 1927 December, Third Science Program, Nashville.
- 1928 December, Fourth National Meeting, Coat-of-Arms adopted, Fourth Science Program, New York.
- 1930 January, Council Meeting, Ritual Revised, Norman, Okla.
December, Fifth National Meeting, Fifth Science Program, Cleveland.
- 1931 Phi Sigma Letters Registered, U. S. Patent Office.
- 1932 December, Sixth Science Program, Atlantic City.
- 1933 June, Sixth National Meeting, Seventh Science Program, Chicago.
- 1935 December, Seventh National Meeting, Eighth Science Program, St. Louis.
- 1937 December, Eighth National Meeting, Ninth Science Program, Indianapolis.
- 1939 December, Ninth National Meeting, Tenth Science Program, Silver Anniversary, Ohio State University, Columbus.
- 1942 December, Tenth National Meeting, Dallas, Texas.

Expansion:

The Constitution provides that: "An active chapter may be established in any institution of learning which requires for graduation the equivalent of four years of collegiate work, and which is equipped with facilities for research work. - - - Any petitioning group must be active for at least one year before it may be granted a charter."

THE BIOLOGIST

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Directory

OF ALL ACTIVE AND INACTIVE CHAPTERS

*The list of chapter officers for this school year will be found in the
CHAPTER NEWS section of Vol. XXVII.*

ALPHA

Ohio State University, Columbus, Ohio, founded March 17, 1915, (Inactive).

BETA

University of Michigan, Ann Arbor, Michigan, founded June 3, 1916.

DELTA

University of Maine, Orono, Maine, founded January 27, 1917, (Inactive).

EPSILON

University of Denver, Denver, Colorado, founded March 5, 1917.

ZETA

University of Wisconsin, Madison, Wisconsin, founded May 30, 1917.

ETA

University of Akron, Akron, Ohio, founded April 20, 1921.

THETA

Michigan State College, East Lansing, Michigan, founded April 9, 1921, (Inactive).

IOTA

Washington University, St. Louis, Missouri, founded May 28, 1921.

KAPPA

University of Kansas, Lawrence, Kansas, founded May 31, 1921.

LAMBDA

Montana State University, Missoula, Montana, founded May 4, 1921.

MU

University of California, Berkeley, California, founded April 27, 1922.

NU

Washington and Jefferson College, Washington, Pennsylvania, founded May 11, 1922.

XI

University of Nebraska, Lincoln, Nebraska, founded May 3, 1934, (Inactive).

OMICRON

University of North Dakota, Grand Forks, North Dakota,
founded May 26, 1924, (Inactive).

PI

Emory University, Georgia, founded January 3, 1925.

RHO

University of Illinois, Urbana, Illinois, founded March 28, 1925.

SIGMA

University of Florida, Gainesville, Florida, founded December 4, 1925.

TAU

Duke University, Durham, North Carolina, founded March 4, 1926.

UPSILON

Miami University, Oxford, Ohio, founded May 7, 1926.

PHI

University of New Hampshire, Durham, New Hampshire, founded May 21, 1926.

CHI

Montana State College, Bozeman, Montana, founded February 11, 1927.

PSI

University of Washington, Seattle, Washington, founded April 7, 1928.

OMEGA

University of Oklahoma, Norman, Oklahoma, founded March 24, 1928.

ALPHA ALPHA

University of Southern California, Los Angeles, California, founded March, 1928

ALPHA BETA

Mount Union College, Alliance, Ohio, founded May 17, 1928.

ALPHA GAMMA

University of South Dakota, Vermillion, South Dakota, founded May 15, 1928, (Inactive).

ALPHA DELTA

Lawrence College, Appleton, Wisconsin, founded March 7, 1929, (Inactive).

ALPHA EPSILON

University of Pittsburgh, Pittsburgh, Pennsylvania, founded March 23, 1929.

ALPHA ZETA

College of William and Mary, Williamsburg, Virginia, founded April 19, 1930, (Inactive).

ALPHA ETA

Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma, founded March 13, 1930.

ALPHA THETA

State College of Washington, Pullman, Washington, founded May, 1930.

ALPHA IOTA

Bucknell University, Lewisburg, Pennsylvania, founded January 9, 1932.

ALPHA KAPPA

Hunter College, New York City, founded January 8, 1932.

ALPHA LAMBDA

University of Utah, Salt Lake City, Utah, founded February 13, 1932.

ALPHA MU

University and State College of Oregon, Eugene-Portland-Corvallis, Oregon, founded November 18, 1933.

ALPHA NU

University of New Mexico, Albuquerque, New Mexico, founded April 21, 1935.

ALPHA XI

Rhode Island State College, Kingston, Rhode Island, founded May 17, 1935.

ALPHA OMICRON

Marquette University, Milwaukee, Wisconsin, founded June 18, 1938.

ALPHA PI

University of Colorado, Boulder, Colorado, founded May 24, 1941.

ALPHA RHO

University of Arkansas, Fayetteville, Arkansas, founded May 23, 1945.

ALPHA SIGMA

University of Texas, Austin, Texas, founded February 2, 1946.

Installation of Alpha Sigma

Chapter of Phi Sigma

Installation of the I. M. Lewis Biological Society into Phi Sigma, national biological honor society, took place February 2, 1946. The club, which was organized at the University of Texas in September 1943, honoring the late I. M. Lewis, was awarded status as a chapter by the chapters of Phi Sigma society in November. The club was also awarded affiliated status in the Collegiate Academy of the Texas Academy of Sciences in November 1945.

Festivities for the installation were open to the public except for the actual installation ceremony. These included a public address, a tea, and a banquet.

Efrén C. del Pozo* delivered a lecture at three o'clock in the afternoon, entitled "Pharmacological studies of some plants used in Aztec medicine."

Leon J. Cole, honorary president of Phi Sigma Society, arrived in Austin February 1st to install the chapter, but was taken seriously ill immediately upon his arrival, so that his scheduled lecture had to be cancelled. A. I. Ortenburger, national secretary, and F. A. Barkley, national vice-chancellor, shared his duties as installing officer for the new chapter.

At the installation banquet, which was held at the Texas Federated Woman's Club, the speakers were T. S. Painter, Acting president of the Uni-

versity, Robert R. Williams, distinguished professor of Biochemistry at the University, and A. I. Ortenburger.

Other features of the installation program were an open house of the biology departments of the University from ten until twelve o'clock, a Collegiate Academy of Science meeting at eleven o'clock, and a tea in the Faculty Men's Club at five o'clock.

The officers of the I. M. Lewis Biological Society who are now serving as the first officers of Alpha Sigma of Phi Sigma are as follows: president, Charles Olsen; vice-president, Jo Beth Walling; secretary, Ruth Lind; treasurer, Kit Anderson; scribe, Calvin Ward; and sponsor, Miss Martha Thurlow. Joe Beth Hagen is serving as chairman of the program committee.

Members from other chapters who affiliated with the chapter are: Fred A. Barkley, Harriet Exline Frizzell, Donald Leslie Frizzell, Elise Greig, Jesse Q. Sealey, Oscar Brown Williams, and Orville Wyss.

Charter members of the new chapter from the faculty were: C. C. Albers, pharmacognosy; Allen Beattie Griffen, Zoology; Benjamin C. Tharp, botany; Martha Thurlow, biology library; Barton Holland Warnock, botany.

The other charter members of the chapter were:

Ethel Marie Harpin

Norman Heard

Robert Haddow

Grady L. Webster, Jr.

* Short sketch of Efrén C. del Pozo will be found along with sketches of T. S. Painter, Robert R. Williams, and A. I. Ortenburger, following the paper by del Pozo.

Joseph Thomas Painter
 Ray McIver
 Calvin Ward
 Kittridge Anderson
 Ruth Lenore Lind
 Jo Beth Walling
 Charles Melvin Olsen
 Guillermo Arroyos G.
 Johanna Blumel
 Charles Boone
 Mary Lynn Brouthertin
 Priscilla M. Chase
 Carol Theodore Isensee
 Dan Leslie Lindsley, Jr.
 Oscar McNaughton Reinmuth
 Marilyn McQuigg
 Lowell C. Smith
 Mary Emma Webb
 Mary Francille Weber
 Martha Wilkerson
 Helen Virginia Weinheimer
 Clair Louise Painter
 Charles Willard Lewis, Jr.
 Barbara Willardine Harrison
 Harold Joseph Harris
 Shirley Wolz Handler
 Lucille Hagan
 Marian Lenore Cramer
 Mary Louise Beene
 Glenda Oglesby
 Peter Marion Chamberlain
 Mary Elizabeth Cheatham
 Frances Clayton
 Rosemary Corman
 Damian Hilsaca y Hilsaca
 LaMar Bate Hilton
 Arthur Milton Jansa
 Harold Jerome Joseph
 Melanie Levy
 Jane Machia
 Edmond Massad Massad
 Betty Ann Newcomer
 Cap Hill Oliver, Jr.
 Babette Rotschild
 Chester M. Rowell, Jr.
 Ronald Arthur Welsh
 Joyce Josephine Wendt
 Charles H. Zimmerman

Margaret Eleanor Tacquard
 Lola Lee Dyess

Following the installation of the new chapter, an initiation of members elected since the affirmation of the chapter by the national group, took place.

Dr. Efrén C. del Pozo, and Dr. Robert R. Williams were initiated as honorary members. Dr. Charles Lewis, a mycologist and brother of the late I. M. Lewis, who had come from Waterville, Maine for the ceremonies, was initiated as a member.

Faculty members initiated were:

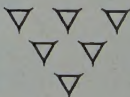
William Jackson Dobson
 MacDonald Fulton
 Addison E. Lee
 Lewis F. Hatch
 Marie Betzner Morrow
 Jack Myers
 William Elmore Norris, Jr.
 A. R. Schrank
 Vernon T. Schuhardt
 Wilson S. Stone
 Robert P. Wagner
 Wilson Jones Walthall, Jr.
 Elizabeth Jane Moore
 D. B. Casteel
 Nina P. Stehr
 Francis Luther Whitney
 Joe B. Wilt
 Linda Wharton McDanald
 Austin Phelps
 Sarah Brooks Martin
 Elmer J. Lund
 Henry Rudolph Henze
 Hilda Florence Rosene
 Frederick McAllister
 Theophilus Shickel Painter
 John Melvin Carpenter
 Hugh Carlton Blodgett
 Lloyd Alexander Jeffres

Active members initiated were:

Edwin Palmer Lowe
 Gwendolyn Tonroy
 Frederick Joseph Korkmas
 Margaret Ellen Russell,

Marie Hruzek
Doris Owen
Mary Louise Alexander
Betsy Ann Bagley
Norma Jean Beauchamp
Samuel Irving Bellman
Clemance W. Burman
Joyce Butler
Frances Davis
Franklin Lee Davis, Jr.
Virginia Lee Smith Dobson
Marie Dugone
Asuncion Duplan
Joseph Durso
Alvin G. Flury
Richard Alden Frankel
Mildred Genelle Fromme
Bunny E. Glasser
William J. Krodell
John Waterman Langley
Dudley Bickner Mathers, Jr.
Peachie Waunelle McDonald
Evallee Miles
Mack Miller Morris
Harry Delbert Thiers
Olivia Salinas V.
Dorothy June Tutt
Fernando Valdez-Morales
Benjamin Quinn Ward
Carrie Ella Whitmire
Grace Marie Orndorff
Mary Jean Stewart
Lucile Lloyd Head
Eb Carl Girvin
Allyn Warren Gill
Nancy Babb
Otis Lynn Vaden
Capt. Roy W. Aldrich

Sister Joseph Marie Armer
William Webster Barkley
Elsie Rodemann
Sidney William Bohls
Helen Boysen
Eula Belle Maley Cook
James Cecil Cross
Ann May Terrance Davis
L. Irby Davis
Mary Taylor Edwards
Victor A. Greulach
Viola Catherine Hamilton
Corrie H. Hooks
Jesse Vernal Irons
Frederick B. Isely
Ellen Schulz Quillen
Robert Gatlin Reeves
Bessie M. Reid
Orville Rice
Robert Runyon
Sister Mary Lucy Corcoran
Sister Mary S. Zagst
Sister Mary Andrew
Wilya Davye Lucas Barkley
Roy Henry Adams
Elizabeth Tyler Painter
Sister Mary Clare Metz
Sister Mary Berenice Trachta
Sister Hilary Beck
Cornelia Marschall Smith
Father Frank Joseph O'Hara
Sister Mary Albertine Kennedy
Benjamin Clayton
Elida Marion Pearson
Sister M. Germaine Rachaner
Robert Milton Adams
Dr. Charles Lewis



*Pharmacological Studies of Some Plants Used in Aztec Medicine*¹

Efrén C. del Pozo

*Department of Physiology,
Instituto Politecnico Nacional
Mexico, D. F.*

Aztec medicine had reached a high stage of development in the XVI century. Though its practice was not lacking in magical devices, it is significant that the professions of physician and sorcerer were practiced by separate individuals. One (tepatli) occupied himself with the material problems of the body, while the other (ticitl) sought to calm the wrath of the gods and to conjure the bad will of the evil ones. Even more, a high degree of medical specialization had been reached. The profession of surgeon (texoxotl-ticitl), that of phlebotomist (tecoami), that of mid-wife (temixiuitiani), that of pharmacist (papiani), and that of drug plant vendor (panamacani) were quite distinct from one another. Several forms of treatment described by the earlier Spanish writers as they found them among the Aztecs in the beginning of the XVI century have not lost their indication in present day medicine. We find washing of wounds, mechanical devices for the immobilization of fractures, suture of face wounds with atraumatic string (hair), opening of abscesses, reduction of dislocations, embriotomy of a dead fetus, diets for the sick, general hygienic measures during epidemics. Their pharmacological resources were innumerable,

and were made from mineral, animal, and plant products.

These last undoubtedly represented the richest source of medical supplies. Commerce in medicinal plants was of great magnitude, and today, more than four centuries after the arrival of the Spaniards, vendors of plant medicines, generally called "Yerberos," are to be found in nearly every market-place in Mexico. The study and the clinical testing of plants occupied the attention of the Aztecs. The botanical gardens at Ixtapalapa, Huaxtepec, Texcoco, Coyoacan and Tenochtitlán, were of such magnitude and contained such a great variety of species that the Spaniards were surprised and filled with admiration. Many writers described the magnificence of these gardens, the devotion with which they were cared for, and the great esteem shown by the Aztec kings for rare plant species; historians have made it clear that expeditions were undertaken, and that agreements were made with other peoples to obtain new species; some towns paid their tribute in plants and flowers, and at one time Moctezuma even declared war on the Lord of Tlachiquiauco because he refused to satisfy the Emperor's demand for the delivery of a highly valued tree. The selection and care of specimens for the gardens demanded ample taxonomic knowledge. The same

¹ Presented as guest lecture. Installation of Alpha Sigma of Phi Sigma, Austin, Tex., February 2, 1946.

may be said about the "pharmacists," or about the medicinal plant vendors. Netzahualcoyotl, the poet king from Texcoco, was at the same time a naturalist who took a personal interest in the care and development of his famous gardens. Moctezuma, not satisfied with the limitations imposed on him by the climate of the Valley of Mexico, developed also the gardens of Huaxtepec where the high temperature favored the cultivation of exotic plants. The medicinal plants in these gardens were used by the court physicians, who also experimented clinically with the new species. It was possible for the people to obtain plants for therapeutic use in the gardens of Moctezuma free of cost, agreeing only to inform of the results obtained upon the patient.

The gathering of statistics was of great importance in this primitive pharmacological investigation.

The Spanish conquerors found themselves seeking the aid of Indian physicians; Cortés himself was attended by them. The wild tales that sprang from this fact found fertile grounds in the imaginations of Europeans awakened by the spectacle of the marvelous discoveries in the New World.

Nicolas Monardes, a famous physician of Seville, in 1545 published a work about "the many things brought from our Occidental Indies that are useful in medicine." This book was soon very popular, and numerous Spanish, Latin, English, and French editions followed one another in the XVI and the beginning of the XVII century.

It is generally admitted that Monardes was never actually in America, yet he not only gathered a great number of facts from the conquerors and travellers who returned to Europe, but also observed personally the effects of the medical samples brought back from the New World.

In 1570 Phillip II sent his own physician, Francisco Hernandez whom he named "Protomédico de las Indias," to Mexico to undertake a detailed and careful study of indian medical resources. His expedition was well furnished with money and facilities for the development of its investigations. During the seven years he worked in Mexico, he gathered a great number of facts, visited the botanical gardens of Atzacapotzalco, Texcoco and Huaxtepec, personally observed the effects of many drugs on the sick, and in 1577 returned to Spain taking the manuscript of his report, but leaving copies of the same in Mexico. This manuscript was kept in the library of the Escorial, where it was partially destroyed during a fire. However, much before this misfortune took place, a napolitian physician, Antonio Recchi, had been charged with preparing an extract of Hernandez's work for publication.¹ Recchi died before finishing his work, but this was finally published in 1628² under the title "*Rerum Medicarum Novae Hispaniae Thesaurus, seu Plantarum, Animalium, Mineralium Mexicanorum Historia*," by the Academia dei Lincei (Fig. 1). Posteriorly, five manuscript volumes of Hernandez's works with corrections made personally by the author, were found in the Library of San Isidro in Madrid. Three of these volumes, those concerning the plants, were published in Madrid in 1790 under the direction of Casimiro Gómez Ortega. This last work has been translated from Latin to Spanish by Prof. José Rojo

¹ The fire that destroyed the Escorial took place in 1671, that is, many years after the publication of Recchi's work. Emmart erroneously says that Recchi based his work on fragments that escaped the fire. There is no excuse for the mutilations to be found in the extract prepared by Recchi.

² This date is fixed by Dietschy of the Museum of Ethnology of Basilea. Gomez Ortega, Emmart and others take the 1651 edition as the first. The frontispiece which we reproduce (Fig. 1) corresponds to a 1649 edition.

and is now being edited, with botanical classification and aztec etymologies by the Instituto de Biología de la Universidad Nacional de México.

Recchi's extract was not the first publication based on Hernandez's work, for already in 1615 Fray Francisco Ximenez who found a copy of Hernandez's manuscript in the convent of Huaxtepec, had published in Mexico under the title of "Quatro Libros de la Naturaleza," a selection and translation into Spanish of the Latin manuscript. This was the first book published about Aztec medicine.

The posterior comparison of these works with new sources of information for the study of Aztec medicine has shown the considerable European influence to be found in the former, no doubt the result of the occidental medical education of the authors. The same may be said of other XVI century publications, and of later ones, such as those of Francisco Bravo, Alonso López, Juan de Cárdenas and Agustín Farfán.

For a long time the best information to be had about Aztec medical botany was to be found in the writings of Fray Bernardino de Sahagún, an eminent franciscan investigator and educator who studied for many years Mexico's autoctonous culture.

In order to obtain information about Aztec medicine, he brought together eight indian physicians at his convent in Santiago Tlaltelolco in 1547, and recorded without professional prejudices the facts which he was able to obtain. An example of the excellent opinion had by Sahagún of the Aztec medicine is to be found in the fact that an indian physician, Martinus de la Cruz was the doctor at the Colegio de Sta. Cruz founded by Sahagún himself for the education of youths descendants of Aztec nobility.

In 1929, Professor Charles U. Clark's discovery of the Badian manuscript in the Vatican library came to throw new light upon the study of Aztec medicine. In 1940 this source of investigation was placed at the disposal of all those interested in the form of a facsimile edition which included Emily Walcott Emmart's transcription, translation, and meticulous study of the work.

The so called Badian manuscript, or Codex Barberini, is a latin translation of an Aztec treatise on medical botany, written in 1552 in nahuatl by an indian doctor Martinus de la Cruz, Juan Badiano, an indian, native of Xochimilco, was only the translator. This work titles "*Libellus de medicinalibus indorum herbis*," can be considered free from European influence; the author and the translator wrote it when only 30 years had elapsed after the conquest of Mexico. In 1552, date which the manuscript bears, both indians occupied important positions in the Colegio de Santa Cruz in Tlaltelolco: Martinus de la Cruz was the college's physician and Juan Badiano was Reader. (Fig. 2).

A valuable characteristic of the manuscript is the richness of its colored illustrations, which have deteriorated marvelously little in almost four centuries, and have permitted the botanical identification of several species. According to Emmart, the drawings, the writing of the aztec names, and the margins of the pages, were probably the personal work of Martinus de la Cruz, who only left spaces in white to be filled in by Juan Badiano with the latin translation of the nahuatl text or notes. (Fig. 3).

This priceless document which has aroused the interest of so many men of letters had remained ignored for centuries. It is very strange that writers on aztec medicine, who wrote

at the time and after the time of Martinus de la Cruz and Juan Badiano, did not mention this work. It is difficult to accept that Sahagún, founder and Prior of the Convent of Tlalteolco, before and after 1552, though perhaps not during the year in which the book was written, ignored its existence. His marked interest in indian medicine, which in 1547 had made him bring eight Aztec physicians together to gather his facts, makes it even more difficult to understand how he could have no knowledge of Martinus de la Cruz's book. Sahagún began his "Historia General de las Cosas de la Nueva España" in 1557 and makes no reference to the herbal. The only plausible explanation is that Sahagún may have been away from Mexico in 1552, and that the work we are considering may have been sent to the Old World immediately after having been finished.

We must admit that we were surprised and disillusioned when, upon reading the Badian manuscript, we found that the author had not limited himself to rational pharmacological resources, but had included a great number of formulas and absurd measures whose actions could only be interpreted in the light of magic. However, this impression which it leaves in XX century readers seems not to have been that which it produced in contemporaries of Martinus de la Cruz. All XVI century writers agree with one another when they affirm that the profession of physician was radically distinct from that of sorcerer, and, if we take into account the fact that the strange therapeutic measures recommended by Martinus de la Cruz always appear as rational prescriptions accessible to any mortal, physician or patient, who might want to put them in practice, we must admit that such medicines are simply inefficient as has been shown in later

days. They are radically different from magical medicine, for here the witch-doctor has supernatural powers which he communicates to persons and things; thanks to secret formulas and only under certain conditions. Perhaps some of the medicines we now use will be looked upon by our descendants as not too different from what we could consider magic measures in our ancestors.

Many of the plants found in the Badian manuscript are still used today in popular medicine and can be obtained in any market-place in Mexico. Others have disappeared from indian therapeutics, while still others are used today that had no reputation in the XVI century.

A despective attitude toward indian medical botany does not seem to us justified. The marked pharmacological actions of some of their plants cannot be denied, nor can centuries of empirical observation be ignored. The examples of cinchona, of the coca plant, of digitalis, and of other plants used first by the indians constitute proofs of the untaught wisdom that results from direct contact with nature. The ancient Mexicans were originally nomad tribes that lived for centuries in forest and prairies; they loved and adored natural phenomena. The Aztecs, and before them the Toltecs, founded botanical gardens, and cultivated plants even over the waters of the lakes in the Valley of Mexico in the form of "chinampas," vegetable and flower gardens, which were a source of food, beauty and health. The god Xochipili, prince of flowers, was also the god of joy, of song, and of play. Visitors to Emperor Moctezuma had to present themselves with flowers in their hands. Flowers and plants were at the same time tribute and offering: tribute to the governors and offerings to the gods. Floral offerings are still of a surprising

richness. Anyone who had visited the Basilica of the Virgin of Guadalupe, or the churches dedicated to the towns' patron saints, will recall the abundance of flowers on the altar, the arches upon the entrance with their fantastic pictures, the carpets resembling Italian mosaics, all made of flowers, of several sizes and colors. This devotion to plants gave the Aztecs an obliged knowledge of their differences and similarities, and forced them to study their utility and properties. Hence the richness of indian medical botany.

In 1946 a large percentage of the Mexican people still treats its diseases exclusively with plants. They do this because of a naiveness which accepts the most miraculous properties of legendary medicine, but above all, for the sake of economy.

The plants are furnished by the "curandero" or "yerbero" for the same meager cost of the visit. On other occasions, the patient or simply a relative goes to permanent or transitory booths in the markets where thousands of roots, leaves, flowers, fruits, etc., are sold. There they buy the previously chosen product, or refer the patient's symptoms briefly. The "yerbero" or herb-vendor generally finds no difficulty in diagnosing, and even less in prescribing a treatment. It is sufficient to know the anatomical site of the disturbance, or the dominating symptom, for the medicines are capable of curing all the diseases of an organ, be it the stomach, liver, or heart, or they can cure a symptom, irrespective of cause. Thus one "yerba" does away with hemorrhages, another with fevers, another with diarrheas. This condition would be simply a curiosity for tourists, if it were not tragical to the health of the people. It is tragically harmful because it impedes or retards the visit to the doctor, and because

many of the plants dispensed have marked pharmacological actions which often harm the patient irreparably. (Fig. 4).

Since a long time ago the pharmacology of plants reputed as medicinal has been sporadically studied in Mexico. Unfortunately the greater part of these studies has been clinical, in small groups of patients. To judge a drug as effective because in a small group of cases recovery followed shortly after its use, does not take into account the possibility that the patients may have recovered despite its use. Experimental work has been scarce. The first worthy of mention was carried on in the Instituto Médico Nacional in México, D. F. in the beginning of this century.

Maximino Martinez has gathered an extensive and useful bibliography in the most complete modern work about "Plantas Medicinales de México." Unfortunately, a great number of the references correspond to simple theoretical opinions regarding the possible clinical actions of the drug. Premature work has also been done in the chemical analysis of plants. No scientific criterion is possible as to the relative activity of various fractions as long as adequate pharmacodynamic knowledge of the plant's activity is lacking.

The experimental pharmacological study of Mexican plants is yet to be made. The studies of this type that have been made are still very few, but already very interesting positive results have been found. Perez Cirera has verified the digitalic action of *Yoloxochitl* (*Talauma mexicana*), or "heart flower" which was used by the Aztecs. Eliseo Ramirez found interesting vascular actions in the "Zapote blanco" (*Casimiroa edulis*). We have recently studied *Cihuapahtli* (Mon-

tanoa tomentosa) with Pardo and Derbez. Montemayor is now working in our laboratories with the "tronadora" (*Tecoma mollis*).

We will make brief references to the result obtained from the study of Cihuapahtli, a plant used by Aztecs to activate labor, and included with that indication in the Badian Manuscript.

Cihuapahtli, also called Zoapatli, is a Mexican plant indigenous to several regions of the country. Decoctions made with it are still used in popular medicine to accelerate labor. Very frequently physicians in Mexico must face the obstetrical problem of a uterus tetanized by an overdose of the drug. For centuries Mexican physicians have debated the therapeutic utility of the plant in cases of uterine hemorrhage and of delayed labor, even though no one has ever doubted its uterine action. Clinical studies have been numerous and discordant. Experimental investigations have been few and incomplete.

We have studied the actions of extracts of Cihuapahtli on the motility of pregnant and non-pregnant uteri. (Figs. 5c and 6c). An immediate response is also obtained, which is due principally to a liberation of adrenaline, as it disappears when the adrenals

are excluded, except when very large doses are used. (Fig. 5A and B).

Uterine responses to the injection of adrenaline or to the stimulation of the hypogastric nerves, are increased after Cihuapatli. (Fig. 6B). This is true in the case of the inhibitory responses of a non-pregnant uterus, as well as in the case of the excitatory responses of pregnant uteri. In no case was the type of response inverted. The potentiation of responses to normal stimuli may be of clinical importance.

Massive doses of Cihuapahtli produced a sustained tetanic contraction in pregnant and non pregnant uteri. (Figs. 5A and 6D).

Potentiation of responses to adrenaline were also found in relation to the pressor effects of this drug, which is the opposite of what is observed with ergotene.

The evidencing of the noteworthy pharmacological actions of Cihuapahtli, known already to the Aztecs in the XVI century, is one argument more in favor of the necessity of undertaking the pharmacodinamic study of indian medical plants. We had already solicited the interest of men of science in this problem during the First Inter-American Indigenist Congress held at Patzcuaro, in 1940.





FIG. 1. Frontispiece of the 1649 edition of Hernandez's book.

Libellus de medicinalibus Indorum her-
bis, quem quidam Indus Collegii Indici
Crucis medicus composuit, nullis
rationibus doctus, sed solis ex-
perimentis edoctus. Anno
domini servatoris.

1552.

Cum istius domini Francisci de la Cruz
illustrissimi superioris huius Indiarum pater
domini Francisci de Mendoza filii optimi
huius de la Cruz, indigenis seruis salutem
prebent plurimum & prosperitatem.

Ex libris didaci...

Cum me omnium vestrum decora atque ornamenta ex
munere, quae a quoniam mortali desiderantur relinquantur, tam me
magis fructuosissime, nescio profecto, quid in te potissimum
idem. Equidem non indeo, quibus laudibus effram inquam
vestrum amorem, quibus verbis gratias agam vestro beneficio
ipso maximo. Pater enim huius videlicet christianissimus, servus
synus; verbis consequi nequeam quod maxime omnium
beneficent, quicquid enim sum, quicquid posideo & quicquid
habeo, illi debeo. Nihil par, nihil ne signum.



FIG. 2. First page of the book by Martin de la Cruz and Juan Badiano. (Taken from Emmart's facsimile edition).

Quauhuala: Cihnapahlli. Quauhala: Mexico.



Recepta pariter remedium
 Mulier s: pariter diffinitionem putitur. que paruo em n. se
 tam eliniet. et adal. medicinam ex arboris quauhualahua
 in aqua laita corlice & herbe Cihnapahlli, lapillo ezeff.
 immolans cauda nomine Itaquahin bibat. Herbam Itanex
 tra manu portet. Et sumu pili et os. aquile ola, arbor que
 Itavexot. ceru pelis, galli gallinay sel, lepons sel.
 insolate cepe comburantur. quibus addantur sal. fruct
 qui nostrate sermone dicitur rochiti. et cetti. Hec sup
 dicta calefiant et succo yngatur. Vulpis uinum coctum
 edat. & humerus smaragdus & italde Vinde marqanti
 alligentur. potest etiam bibere mulu tiri sum et. nise
 ris et Itaquahin cauda succum in doli. nostrate vino. cal
 tomali quoq: canhi. Itaquahin cauda. et cihnapahlli felia te
 rantur. quorum liquore Vulpia imbuatur. Ammanis. quoc
 Itaquahin tere candam magna. et herbam cihnapahlli. pro
 succo fiantem elyteri infuso sanato vel purgato.

FIG. 3. A page from the book by Martin de la Cruz and Juan Badiano in which Cihnapahlli is illustrated and its properties discussed. (Taken from Emmart's facsimile edition).

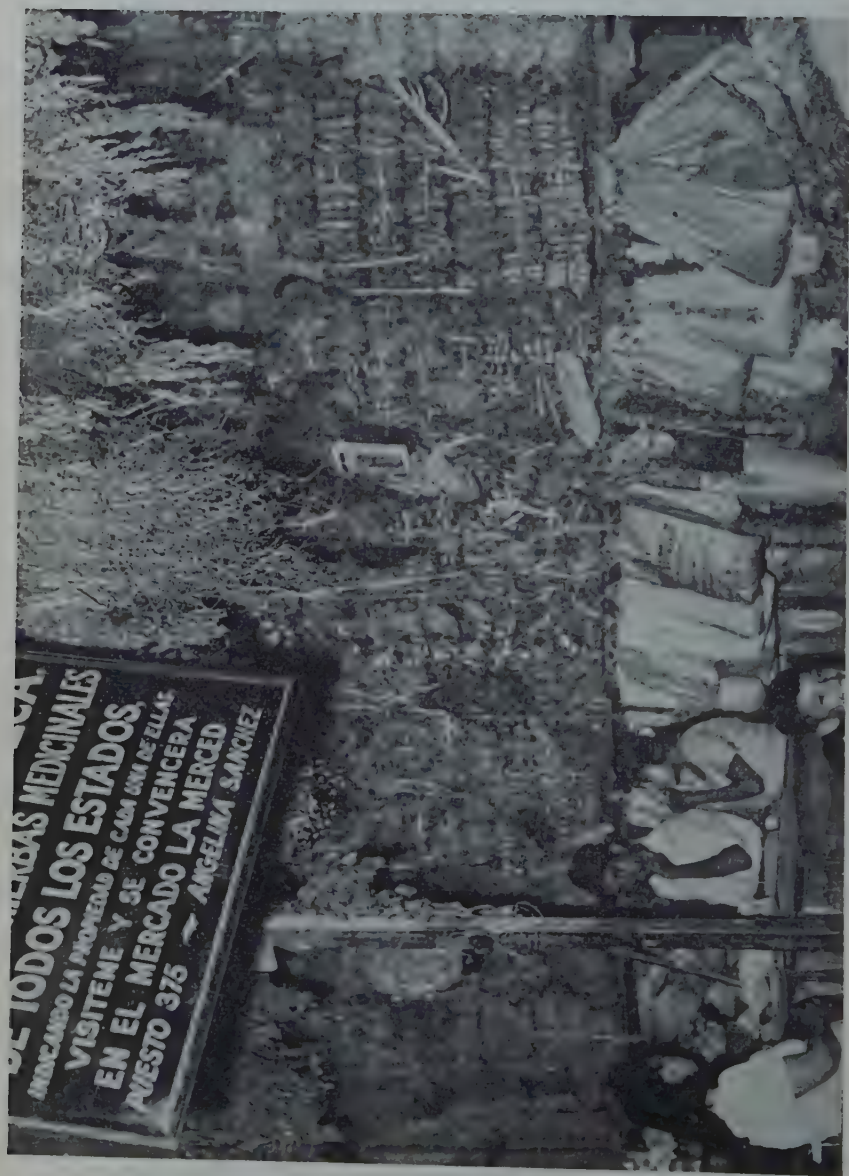


FIG. 4. A herb store at the Mercado de la Merced, in Mexico City. The sign, which is incomplete in the photograph reads: "Booth 'Los Indios.' Aztec Botany. Medicinal herbs from all the states are sold, with indications as to the properties of each. Visit me, and you will be convinced. Mercado de la Merced. Booth 375."

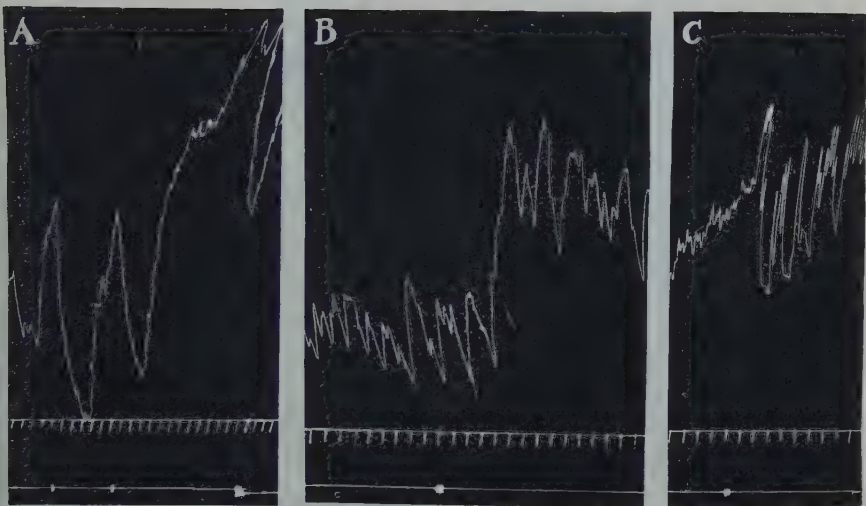


FIG. 5. Effects of Cihuapahtli on the tone and rhythmical activity of non-pregnant cat uteri. In this and the following figures the upper signal records 60 second intervals.

A. At the first mark of the lower signal, injection of 0.5y of adrenaline. At the second mark, injection of an extract of Cihuapahtli. Other doses have been previously injected. A primary inhibitory response, and a considerable increase in tone. At the third mark, stimulation of the hypogastric nerves during 30 seconds.

B. (In another animal, after the exclusion of the adrenals). The lower signal marks the injection of an extract of Cihuapahtli. There is no primary response, and only an increase in tone is produced.

C. (In another animal.) The lower signal marks the injection on an extract of Cihuapahtli. A considerable increase in the amplitude of the spontaneous contractions.

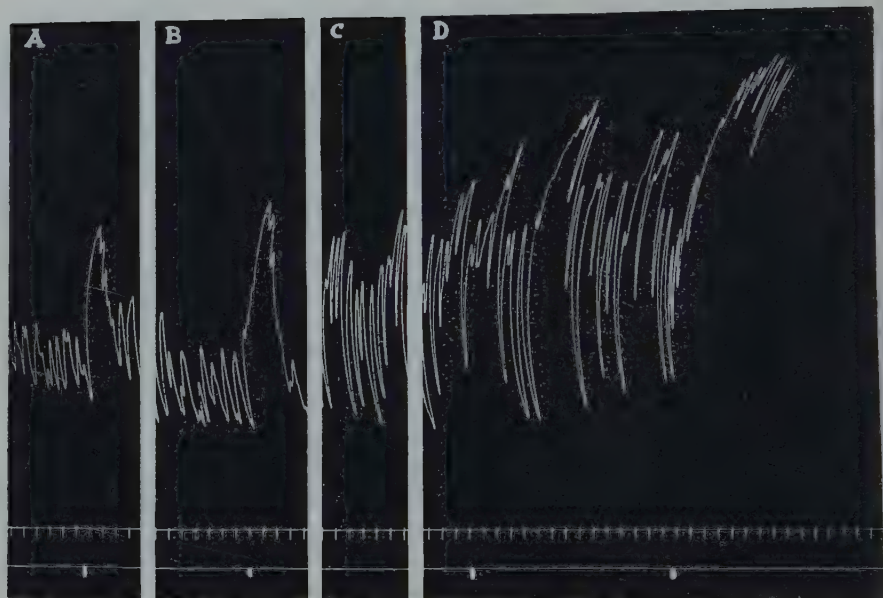


FIG. 6. Effects of repeated doses of Cihuapahtli on the tone and activity of a pregnant cat uterus.

A. The lower signal marks the injection of a first dose of Cihuapahtli. The lower mark corresponds to the injection of 2y of adrenaline.

B. Twelve minutes after the injection of the first dose of Cihuapahtli. The lower mark corresponds to the injection of 2y of adrenaline. The excitatory response is potentiated.

C. 42 minutes later, and five minutes after the injection of a second dose of Cihuapahtli. A marked increase in the amplitude of the spontaneous contractions is to be observed.

D. One minute later. The first mark of the lower signal corresponds to the injection of a third dose of extract of Cihuapahtli. The second mark corresponds to the injection of a fourth dose of the same extract. The progressive increase of the contractions can be observed, as well as the gradual rise in tone, up to complete tetanization of the uterus.



Personalities

EFREN C. DEL POZO

Dr. del Pozo is head of the Laboratory of Physiology and Pharmacology and professor of Physiology in the Institute of Medical and Biological Investigations of the University of Mexico, professor of Physiology in the Polytechnic Institute of Mexico, professor of Physiology in the National School of Biological Sciences, and until last year the head of the Laboratory of Physiology and Pharmacology of the Tropical Medicine Institute of Mexico and Dean of the National School of Biological Sciences of Mexico. He holds the M.D. degree from the University of Mexico, and held a post-doctorate fellowship at Harvard University for three years. He worked in this country from 1941 to 1943 on a John Simon Guggenheim fellowship. He is the author of some twenty research papers dealing with the problem of the physiology of fatigue.

T. S. PAINTER

T. S. Painter, research professor of zoology since 1937, a member of the National Academy of Sciences, is noted for his researches in cytogenetics. He holds the Ph. D. and Sc. D. degrees from Yale University.

ROBERT R. WILLIAMS

Robert R. Williams was formerly the chemical director in the research laboratories of the Bell Telephone in New York. Having made important achievements in the field of biochemistry, particularly in the structure, synthesis and use of vitamin B₁. He has been given numerous awards and medals of national importance and has had the honorary degree of Sc. D. conferred upon him by Ottawa University, Ohio

Wesleyan University, and Chicago University.

FATHER KEEFE RETURNS

Father Keefe, who was Major Keefe as well as Chaplain in the armed services has returned to civilian life and is resuming all of his former duties. As you know he was Editor of the *BIOLOGIST* before entering the army. He was reappointed the Editor of the Journal, to begin his duties with the first issue in the fall of 1946.

At a meeting of the National Council held March 29-30, 1946, Dr. Richard B. Goldschmidt was appointed honorary National President, succeeding Dr. Leon J. Cole. Dr. Goldschmidt's term will begin January 1, 1947.

The National Secretary was directed to obtain votes from the several chapters relative to the next National meeting. It was the unanimous opinion of the National Council that a meeting should be held with the A.A.A.S. in December, 1946, in Boston, but that this should be decided by a chapter vote to be in by June 1, 1946.

ARTHUR IRVING ORTENBURGER

Arthur Irving Ortenburger, formerly assistant curator of herpetology at the American Museum of Natural History, has been at the University of Oklahoma since 1924, serving as curator of vertebrates in the University of Oklahoma Natural History Museum, as professor of zoology since 1936, and chairman of the Department of Animal Sciences since 1942. He holds the Ph. D degree from the University of Michigan. He has served for nearly twenty years as national secretary of Phi Sigma Society.

REV. F. E. C. WILLIAMS

Rev. F. E. C. Williams, member of Eta chapter of Phi Sigma, started an unusual program at Korea's "rural bias" school a generation ago—1908. He is an educator, agriculturalist, and Christian leader. He was placed at the head of Konju High School and began developing a practical curriculum.

"With an enrollment of 300 boys, Principal Williams and his staff taught the skills of good farming, showing his students how to distinguish themselves as capable farmers instead of throwing their lives into fruitless peonage.

Rural life development—so essential to Korea—has moved on apace. Hundreds of boys under Mr. Williams have become tillers of the soil, and possess scientific knowledge of the care of

trees, poultry, dairying, rabbit and goat raising, carpentry, tin-smithing, and tool making.

Korea's embryo preachers studying at the "rural bias" school have entered their parishes as practitioners of the plow as well as evangels of their needy people.

Girls enrolled at Kongju have enhanced their lot by learning to sew, cook, weave, care for children (with practical experience in the baby clinic and day nursery), plant and care for mulberry trees, and raise silkworms.

Wartime evacuation of missionaries from Korea separated Principal Williams from his "rural bias" school. Now in India, he has confidence in his native Christian collaborators who vowed to carry on the work until his return."



Beetles

By
MELVILLE H. HATCH
Professor of Zoology
University of Washington

I. How Beetles Came to Be

The story of beetles goes a long way back—some 2000 million years or so—to the time when bits of carbonaceous materials first ceased to be just inert particles of matter and became centers of organization and, hence, *organisms*. The first organisms must have been extremely tentative things,—they had so many lessons to master before they were really fit to make their way in the world.

First, they had to learn that no static organization, no matter how highly perfected, had any real permanence. Subject as it was to environmental vicissitudes no individual organism could hope to endure indefinitely. Eventually something was sure to happen to it to bring about its destruction. Only those organisms that innovated reproduction and growth established their kind. The rest perished. The law of natural selection and the survival of the fittest was one of the first biological principles to be established.

Reproduction, however, carried hazards just as did its absence. In a finite world food tended to become exhausted.

Without seeking to go into detail as to the energy and chemical relationships involved, it may be that no single type of organisms can exist alone simply by eating others of its own kind or their own waste products any more than the proverbial washer-women can live by taking in each others laundry! Only when more than one type of reproducing organisms appeared together, each capable of feeding on the waste products of one of its fellows, did a world-community of living things arise that did not eat itself out of house and home.

But there were other consequences to reproduction besides the necessity of a balanced world-community. It is convenient at this point to think of our organisms as simple bacterial cells each growing and dividing in repetitious cycle. The result of the organizing activity of the growing organism was to reproduce a pair of new cells approximately similar to each other and to the parent cell from which they came. The parent organism existed by virtue of it having met certain environmental conditions that still remained to be encountered by the progeny. Free variation was clearly prohibited; heredity was established.

The dividing cell is, however, an actual rather than an ideal mechanism. Probability and chance govern its destiny rather than strict logic. While it usually divides into similar parts, occasionally it fails to do so, and thus came into existence variant lines. Due to the constant pressure exerted on the means of livelihood by every organism as a result of its reproductive capacity, favorably varying organisms are favored and unfavorably varying or even simply static ones are eliminated in the struggle for existence by natural selection. Thus there came about the extinction of intermediate types, and

species and the other categories of our classification came into existence by virtue of the gaps that extinction leaves in the natural series.

As has already been emphasized, no organism lives to itself alone. Accordingly, every time a new type of organism comes in or an old type goes out, the entire world-community of organisms must react to the event. New types of living things mean new dangers, new challenges, new opportunities. The result was that, veritably pulling itself up by its own boot-straps, the world of life gradually assumed the complexity we now observe.

The first successful organisms, the bacteria and the blue-green algae, were completely without sex. The life-cycle consists of an unending series of simple divisions. But beyond these sexual reproduction appeared. Sexual reproduction involves a periodic union of cells resulting in a mingling and diffusion of traits from diverse lineages. This promotes variability and, hence, evolution so effectively that, above the level of the organisms just cited, sexual reproduction is nearly universal throughout organic nature.

Eventually the great types of living things became established. At the bottom were the bacteria, concerned with the basic transformations of nitrogenous and carbonaceous substances without which no other life is possible. Then there were the green plants, functioning to transform the radiant energy of sunlight into the chemical energy of carbohydrates upon which they and all other living things subsist. Finally there was that race of parasites, the animals, eating the green plants and each other and developing the complex stimulus-reactions necessary to find their way around to the food supplies on which they were dependent.

In the course of time organisms with their microscopic relatives made necessary other complications. Animals developed nervous and circulatory systems to keep them functioning as units —i.e., to keep them organisms. Gills developed to enable them to absorb sufficient oxygen to oxidize the carbohydrates from which they got their energy, and skeletal systems gave the larger bodies rigidity and protection.

Finally organisms discovered the land. The event is documented in the rocks. Probably almost since the origin of life itself, the lands had stood bleak and unpopulated except, perhaps, for occasional patches of bacterial or algal scum. For some 1700 million years they bore witness to the folly of the heresy that environment alone, without the responsive organism, can produce anything. And then, in the Devonian, the plants discovered this empty habitat that had been so long awaiting them. Roots for feeding, stems for support, leaves for the capture of energy and air, spores for the protection of reproductive cells from evaporation—these were the initial organs with which the plants conquered the land.

Nor could the animals long resist the new habitat that the plants had provided for them. Within a hundred million years the lung-fishes had evolved into the first salamanders (*Stegocephalia*) and the marine arthropods (*Crustacea et al.*) had produced centipedes (*Myriopoda*) and spiders (*Arachnida*). Both groups protected their germ-cells from the evaporating effect of the air by depositing the sperm directly in the body of the female and developing the fertilized egg within the female or within a protective shell. The vertebrates secured rigidity by means of an inner or endoskeleton, the arthropods by means of an outer or exoskeleton. The vertebrates converted

the gaseous oxygen of the air into the dissolved form that they required in a richly vascular sac or lung that they alternately compressed and relaxed. The arthropods accomplished the same results in semi-rigid sacks, tubules, or trachea in the body into which the oxygen of the outer air diffused as it was there taken up by the animal's blood or tissues. The mechanics of the tracheal and exoskeletal systems were such that the terrestrial arthropods were forever limited to small bodily size, while the vertebrates were able to develop to greater dimensions. Arthropods grow, for instance, by periodically shedding their exoskeletons and expanding to a new size while in a soft condition. The result that the vertebrates and the arthropods divided the land between them and continued to evolve in essentially non-competitive spheres.

The most successful of the land arthropods were the insects. In the first place, they reduced their legs to three pairs, which proved entirely sufficient for all practical purposes. In the second place, they developed wings!

Getting into the air has had the same import for the evolution of terrestrial animals as a whole as it has had for modern warfare, and the same dominating position has rewarded the aerial invaders in both instances. In point both of numbers and of specific diversity, birds are the dominant vertebrates, and insects, most of which are winged at some stage of their existence, make up about 75% of all animals and 80% of free-living terrestrial types.

The first winged insects were, apparently, dragon-fly-like creatures of Pennsylvania time, some 250 million years ago. Entomologists call them *Palaeodictyoptera*, which, being translated, means "ancient net-wings." Like modern dragon-flies, their wings stuck

out straight from their body in both use and repose. Unlike dragon-flies, which have "learned" to fold their wing-pads back over their bodies in their immature stages, the developing and not yet functional wings of these "ancient net-wings" extended out straight from the body, just as did the functional wings of the adult. Unlike dragon-flies, again, they were probably slow clumsy flies. Finally, these ancestral forms not content with the two pairs of wings of the modern insect had vestiges of a third pair on the segment immediately behind the head!

These details are important because, paradoxically, one of the first problems confronting the winged insect was how to get rid of its wings when not in use. Nothing is more useful than wings when one wants to go somewhere rapidly and efficiently. Nothing is more annoying when one wants to busy himself with affairs on the ground. An airplane in heavy street traffic epitomizes the problem that these first winged insects faced.

A variety of solutions were discovered by various evolutionary lines. A very few became parasites and lost their wings entirely; the lice, the fleas, the bed-bugs, and a few others are the result. The developmental stages, when the wings are never far enough developed to be of any use, almost at once "learned" to fold the wing-buds over the back and then to make them entirely internal structures, so that no one looking at the modern caterpillar would guess the complexities of the moth or butterfly to come. In the case of the adult stage, likewise, the device of folding the wings compactly over the back when not in use was adopted by the great majority of types. The moth, the house fly, the honey bee are familiar examples. Termites and ants dispense with wings entirely ex-

cept during the dispersal flight of the sexual forms, and plant lice develop wings only every few generations when one plant becomes overcrowded and they are required to use them in flying to another. The great success of these groups of insects shows that wings do not have to be used very often to remain of great value to the species.

The beetles, however, represent the acme of insect development as regards their handling of the problem of wings. Intermediate between them and the Paleodictyoptera were the cockroaches. The fossil record of this ancient group of organisms goes back almost as far as that of the Paleodictyoptera themselves, showing that they were an early offshoot of that stock. The wings and wing-buds of cockroaches are laid flatly but loosely over the back, and for nearly 250 million years they have been living on the vegetable debris of the forest floor, especially in the warmer portions of our planet. The front wings of the cockroaches, moreover, became thickened, losing somewhat the powers of flight and serving as wing covers for the membranous hind wings which, when not flitting, the insects drew up under them in fan-like folds.

The beetle simply completed the process of combining to the full the advantages of a completely winged and a completely wingless animal that the cockroach had begun. The wing-covers came to meet in a firmly locked suture down the middle of the back and took on the structure and texture of the rest of the body, so that their owner was able to slip into crevices and otherwise run around with all the freedom of movement of a completely ground-inhabiting animal. Underneath the wing-covers the second pair of wings remained membranous. While folded into a rather complex system of folds, they were ready at a moment's notice to be

unfolded, enabling their owner to take flight with the ease and efficiency of a completely winged animal. In immature beetles, moreover, the wing-buds became internal, leaving the "larvae" free to adapt themselves to whatever mode of life seemed most opportune.

The Permian period, from the latter third of which the first beetles date, was a critical time in the earth's history. In its early phase extensive elevations of the earth's crust occurred in many portions of the world. New lands cut off the former free flow of ocean currents from the equator towards the poles. Lofly mountain ranges kept moisture laden winds from the interior of the continents. The result was that in the northern hemisphere vast deserts and in the southern hemisphere great continental glaciers took possession of the land. The plant and animal types that had developed during the salubrious climate of the Devonian and Mississippian periods found themselves confronted by new and untoward conditions. It was a question of evolve or perish. Most of them perished: the primitive land plants, the primitive amphibians and reptiles, the primitive insects, in important measure passed from the scene. It is at least a legitimate speculation that the higher coniferous plants, the higher reptiles (whence birds and mammals), the beetles, and some of the rest of the higher insects developed as the result of the harsher climatic conditions of Permian time.

Thus came into existence the beetle-type, so perfectly attuned to the exigencies of terrestrial life that upwards of one-third of all animal species and nearly one-half of all winged insects belong to this one order.

II. How Beetles Evolved

The first beetle is known from Australia in the late Permian Period. The

200 million years that have elapsed since beetles came into existence are small in comparison with the 1800 million years more or less from the time when living things first began to stir that were required to produce the first beetle. In the scale of the history of life the beetle is as recent as science and western European civilization are in the scale of written human history.

The over-all adaptations of the beetle have just been described: a tiny creature from one to 150 millimeters in length combining in unbelievable perfection the advantages of an aerial and a terrestrial animal. The first beetles were probably quite cockroach-like in their habits, living on the vegetable debris of their late Paleozoic and early Mesozoic forest home. But the cockroaches remained just that—scavenging poor relations. The beetles—the city cousins who made good—had the biological wherewithal to pass from one habitat to another and to conquer the world!

The environment of these first beetles was a world of ferns and conifers and cycads, of land snails, of reptiles—giant and otherwise, and of an increasing variety of insect types, all of which provided ample opportunity for the beetle's adaptive powers. We assume that the first beetles were scavengers, but the advantage of tracking their food to its source and feeding directly on the plants and animals themselves must have proven an attraction that was not long resisted. In each habitat, as it was occupied, there proved to be two sources of food: the inanimate organic food itself and the lesser insects and other organisms feeding on that substratum. Accordingly, in almost every situation, two types of beetles developed, the substrate feeders themselves, and the predators, the latter feeding not so much on the sub-

strate feeding beetles as on the host of other insects and other organisms that were present.

The primitive role of the beetles was probably that of scavengers, feeding on the organic debris that accumulates in various situations such as underneath the bark of fallen trees (Tenebrionidae, Cucujidae), the decaying tree itself (Lucanidae, Passalidae), the nests of mammals and birds (Dermestidae), and the food caches of bees and squirrels. The dung of herbivorous vertebrates furnished a livelihood for other types (Scarabaeidae, Hydrophilidae) as did likewise the carcasses of the animals themselves (Silphidae, Dermestidae, Scarabaeidae, Nitidulidae), but some of the beetles in the former substance (Staphylinidae, Histeridae) and most of those in the latter (Staphylinidae, Silphidae, Histeridae, Cleridae) became predators on the fly maggots rather than feeders on the substratum. Some of the carrion feeders (*Nicrophorus*) developed the ability to bury small carcasses before laying their eggs or themselves feeding on them, and some of the dung feeders sink shafts under the dung in which they store up a supply of food (*Geotrupes*) or make a ball of dung which they roll off before burying it (*Scarabaeus*, *Canthon*).

From the scavenging habit, the types of specialization took numerous directions. First, perhaps, may be mentioned the ground dwellers, ranging about over the surface and seeking shelter, especially in the day time, under stones, leaves, and fallen trees. Among the vegetarians in this situation are the darkling beetles (Tenebrionidae), especially prevalent in arid country. Among the predators are some of the rove beetles (Staphylinidae), with short wing covers, the ground beetles (Carabidae), and the tiger beet-

les (Cincindelidae). The adults of the latter in particular combine running and flying in tracking down their prey. The ground dwellers specialized for the occupation of many different situations. Damp situations and dry, mud flats, river and lake beaches, ocean beaches, salt flats and the shores of alkaline lakes, alpine meadows and the margins of glacier fed streams, all are likely to be occupied by characteristic types. Some (Cychrini and certain Lampyridae) have a slender head and prothorax to enable them to reach into the shells of land snails and feed on the occupants. Others (*Calosoma*, *et al.*) climb trees after caterpillars. Others like the blister beetles (Meloidae) prey in the larval stage on the eggs in the egg-cases of grasshoppers, and others, like the fireflies (Lampyridae), produce a flashing light for attracting the opposite sex at the time of mating.

Certain types among the ground-dwelling beetles (Carabidae, Cincindelidae, Tenebrionidae) tend to lose their hind wings. Nature, after having gone to so much trouble to combine in one creature a winged and terrestrial animal, perversely allowed the power of flight to slip away whenever the terrestrial adaptations alone became sufficiently perfected. Nor are these wingless and semi-wingless beetles rare. They occur especially on oceanic islands, like Madeira, where Darwin argued their apterous condition prevented them from being blown out to sea.

Perhaps the most remarkable of the ground dwellers are those that have invaded lime-stone caves (Carabidae, Silphidae). Here their eyes and their pigmentation, as well as their hind wings, were no longer kept up to par by the constant pressure of natural selection but were allowed to vary. Under such circumstances the almost

inevitable tendency of the organism is to degenerate, and we find caves inhabited by a series of wingless pale colored types whose eyes have usually so far degenerated that the surface of the head is entirely smooth in the region where eyes occur in their free living relatives. But the tactile organs, the antennae and sensory hairs, far from becoming reduced, have increased frequently to twice or more their original length. The basis of cave life is the slight amount of organic matter carried in from the surface by the springs and streams that water these strange places.

Related likewise to the ground dwellers are the water-beetles, both predators (*Dytiscidae*, *Gyrinidae*, larval *Hydrophilidae*), plant feeders (*Halipidae*), and scavengers (adult *Hydrophilidae*). The conservative adult stages all remained air breathers, in consequence of which beetles never get out of shallow water where they can make frequent trips to the surface for fresh air and where, likewise, the larvae can resort to the shore for transformation into the adult. The more plastic the larvae, however, frequently developed gills for purposes of aquatic respiration. Within these limits, however, numerous habitata offered by fresh-water ponds, lakes and streams were occupied, and even alkaline lakes and hot springs sometimes were invaded by peculiar species (*Dytiscidae*).

Most modified of the water-beetles are the whirligigs (*Gyrinidae*). More perfectly adapted than many water-beetles for a submerged life in the immature stages, the adults feed exclusively at the surface, on insects falling onto the water, and dive only to seek protection. They swim rapidly by means of powerfully developed hind legs, but more remarkable than this, the eye on either side of the head is

divided into an upper and lower portion. The water-line passes right between the two portions of the eye, so that the upper eye looks up into the air and the lower one down into the water!

Passing now from the ground and water beetles, we go to those which, from the primitive scavenging habit took up a mode of life in closer and closer association with living plants¹. The way lay open from the primitive habitat and must have been earlier tried out by numerous types. Here, too, we begin to notice an increased differentiation between adult and larval life, though such a cleavage is likewise manifest in some of the types already mentioned. Most beetles are obviously more restricted in the wingless larval than in the winged adult stage, and this is especially true of the carrion, dung, and aquatic types. In the forms now to be considered, however, in many instances, the cleavage becomes even more extreme. More and more the burden of biological functioning is pushed back onto the larval stage, and the adult becomes in extreme instances little more than a distributive reproductive mechanism. Beetles never carried this process to the limits that certain other insects like the May-flies and stoneflies have, but there are numerous instances in which the larva takes from one to three years to mature while the adult is active for only a few days or a week or so.

First, among the plant-feeders, may be mentioned the fungus beetles, both those that feed on the fungus directly (*Cisidae*, *Erotylidae*, *Tenebrionidae*, *et al.*), and those like the rove beetles (*Staphylinidae*) that are predators. On

¹For the benefit of professional coleopterists, I must enter a disclaimer against any intention to outline a scheme for the evolution of beetle ecology. Undoubtedly, in actual fact, the habits here mentioned have been assumed repeatedly in beetle-evolution by stocks of diverse ecology.

the other hand are the host of types associated with the higher plants. This is an aggregate that must have undergone a marked expansion as the 130 million years of the Mesozoic progressed. During the first half of this era the apex of plant evolution was represented by the conifers, and we can suppose that those beetles developed that are specially related to this type of plants. The wood of weakened and dying trees was consumed by the boring larvae of the wood borers (Cerambycidae, Buprestidae) and the bark beetles (Scolytidae), some of which, especially of the latter, learned to attack the fully healthy tree. The burrows of these beetles were invaded by predatory forms (Cleridae, Ostomidae), though here as elsewhere the chief insect enemies of beetles have never been other beetles but predatory and parasitoid members of the insect orders Hymenoptera or Ichneumon flies and Diptera or two-winged flies.

With the appearance of the angiosperms in the mid-Mesozoic (lower Cretaceous) the way was open for the expansion, if not the initial development, of the leaf-feeding beetles (Chrysomelidae, Scarabaeidae)^{*} and the leaf-inhabiting predators. The latter include the lady beetles (Coccinellidae) which feed on plant lice and plant mites, and the fire-flies and their allies (Cantharidae, Lampyridae). The pollen of the flowers becomes the favorite food for certain of the adults (Cerambycidae, Dermestidae, Byturiidae, Scarabaeidae, Mordellidae); the seed-pods of the Leguminaceae became the breeding places of the bean and pea weevils (Mylabridae); and the roots became the source of sustenance for the immature stages known as wire worms (Elateridae, Tenebrionidae), white grubs (Scarabaeidae), and others (Chrysomelidae).

The apex of all beetle evolution reached in adaptation of angiosperm development was that attained by the weevils (Curculionidae), the most highly evolved and most numerous in species of any of the beetle families. The head in this most remarkable group of beetles, for no very clear-cut function, is extended in a long beak with the tiny mandibles and other mouth parts at the extreme end. The immature stages, unlike most other beetle larvae, are legless grubs that undergo their development in important measure embedded in the living tissues of plants.

The angiosperms were not the only innovation of the late Mesozoic period of the earth's history. About the same time certain wood-eating cockroaches and certain ground inhabiting wasps independently began to develop complex insect societies. The nests of the termites and the ants were invaded by a series of beetles: predators feeding on the ant's brood and the other insects and mites present, and termitophiles and myrmecophiles. The members of termite and ant societies produce exudates on the surfaces of their bodies that other members of the colony lick off; and it is believed that this habit of mutual licking, trophalaxis, was developed by natural selection as a mechanism of social solidarity. Those ants or termites who were most strongly attracted by the "taste" of their fellows formed the most coherent colonies! The termitophiles and myrmecophiles are beetles which have secured adoption into termite and ant colonies by producing the proper exudates. But there is one vital difference between a termitophile or myrmecophile and a regular member of the colony. The beetles do none of the work of food gathering or caring for the nest or brood but are social par-

asites, and sometimes, especially in the larval stage, they even prey on the brood of the host insect. A long series of beetles have acquired this habit: rove beetles (Staphylinidae) and others (Histeridae, Scarabaeidae) and even entire families (Paussidae, Pselaphidae, Scymenidae).

Beetles themselves display practically no tendency to form colonies of their own and have remained in general "rugged individualists." Scattered species however in diverse families exhibit what may be called subsocial habits. The ambrosia beetles (Ipinae and Platypodidae) bore into the wood, usually of dying trees, carrying in with them the spores of a fungus, different for each species, which grows on the wall of the burrow and provides food for both adults and young. Certain Cucujidae (*Coccodotrophus* and *Eunausibius*) hollow out the leaf-petioles of the *Tachigania paniculata* tree in British Guiana. The burrows are invaded by mealybugs (*Pseudococcus*) which furnish both adult and larval beetles with their nutritious honey-dew. Some of the dung beetles (Scarabaeidae), as has been mentioned, bury pellets of dung on which the larvae feed (*Scarabaeus*, *Sisyphus*) and others (*Copris*, *Minotaurus*) actually stay by the developing larvae and escort them to the surface after they have matured. A nearer approach to true societies, however, is furnished by the Passalidae and a South American tenebrionid, (*Phrenapates*). These beetles excavate burrows in decaying logs. So dependent are their larvae on the parents that they cannot feed on wood particles until they have been chewed up by the adults, and, in the case of the passalids, treated by a digestive enzyme. The members of the passalid's family are supposed to be kept together by

squeaking sounds produced by both larvae and adults as they move through their burrows. Finally, the burying beetles (*Nicrophorus*) enter small carcasses in the ground and stand by until their eggs hatch. They then feed the larvae for the first several hours of their life by the regurgitation of partially digested carrion.²

And so, by the end of Mesozoic time, about 60 millions years ago, the pattern of beetle life was set. This is not to say that the Cenozoic has not seen changes; the continued diversification of the angiosperms, the habitats offered by the nests and dung and carcasses of the warm-blooded vertebrates, the arctic rigors of the Pleistocene glaciation, are factors that may have made for further evolution. But the rise of birds and mammals, at least until the advent of man, did not introduce important new factors. The wingless beaver-parasite (*Platypsyllus*) is almost the only beetle parasitic on a vertebrate.

The evolution of the species of course went on, but it may be suspected that there has been slight change in the total number of beetle species in existence at any one time since the Mesozoic Era. There is little to suggest how long a given species persists once it appears. One can guess that at intervals of somewhere between 50,000 and a million years most of the species of an old beetle fauna are replaced by new ones. At the present time some million, or perhaps five or ten times that number, of species exist on the earth. Something over two hundred thousand of these have been described.

III. Beetles and Man

For the greater portion of man's life on earth he has had little to do with the beetles or they with him. The first

² Data mostly from W. M. Wheeler, *Social Life Among Insects*, 1923, pp. 19-41. For *Nicrophorus* see W. V. Balduf, *The Bionomics of Entomophagous Coleoptera*, 1935, pp. 71-74.

intimation that the beetles may have had that there was something now astir in the world may have been when Paleolithic man began forming his kitchen middens or garbage dumps. In these situations vast number of scavenging and predatory beetles must have flourished. Contrariwise, the first intimation that man may have had of the existence of beetles may have been when he found his furs and leather goods subject to attack by species of the family Dermestidae. The modern house-wife, when she combats carpet beetles (*Anthrenus*) in her home, may be just continuing the fight that began when men of the Old Stone Age began to store their pelts in the corners of their caves.

When human ingenuity had further advanced, in the Neolithic Period, so that wheat and other grains were being stored for future use and ground into meal, and wool was being spun into cloth, the way was opened for a series of species to take up their abode in close association with human affairs. The grain and rice weevils (*Calendra granarius* L. and *C. oryzae* L.) that attack the whole grain moved into the granaries from the fields, and the bean and pea weevils (*Mylabridae*) did the same for the harvest of beans and peas. The meal was attacked by a series of scavengers (*Tenebrionidae*, *Cucujidae*, *Ostomidae*, *Anobiidae*, *Lathridiidae*) that had before lived on the debris that accumulates under the bark of dead tree trunks. And the larder and carpet beetles (*Dermestidae*) were ready to attack the smoked and dried meats and the woollen fabrics. Man's wood products, too, were at times subject to beetle attack (*Lyctidae*, *Anobiidae*) but not in as striking fashion as his stored food and woollens.

As the sway of Neolithic and civilized life gradually increased, the beetles

traveled with it. Though the details are conjectural, it appears that certain species whose original home seemed to have been in the region from the Mediterranean Sea to India slowly came to have nearly world-wide distribution. But let not man flatter himself that he has really much affected the beetle's way. The range and numbers of individual species has enormously increased, but there is no authentic instance in which the structure or basic responses of a beetle has altered in adaptation to the presence of man. A possible exception is the flightless grain weevil, but there is no real reason for not believing it had already lost its hind wings before it began to live in association with man.

Similarly, man's field and garden crops were subject to attack by the insects that lived on the same plants in their uncultivated state. There was this difference, however, that now man was using his ingenuity to grow the plants in solid stands, so that the multiplication of the offending insects was greatly encouraged. Finally, as agriculture spread, the old insects spread with it, and new insects were from time to time encountered and incorporated into the ever-growing fauna with which man has to contend.

A striking recent and fully documented example of this is furnished by the Colorado potato beetle (*Leptinotarsa decimlineata* Say). The potato (*Solanum tuberosum* L.) was introduced to Europe from Peru in the sixteenth century. The potato beetle evolved in the Rocky Mountains on a related plant, *Solanum rostratum*. When the area of potato-culture came into contact with the original range of the beetle, sometime before 1864, the beetle found it could feed on the potato likewise, began to spread out, by 1874 had reached the Atlantic Ocean, and since 1919 has been

accidentally introduced into France and has spread over most of the country.

Another well-established instance of the recent spread of pest is the cotton boll weevil (*Anthonomus grandis* Boh.) The legless larvae of this beetle grow in the developing cotton heads and destroy the fibers. Previous to 1893 the species had not spread beyond its native home in the highlands of northern Mexico. Then in that year it passed into Texas and despite every quarantine and other precaution that could be devised, it spread year by year until by 1922 it covered nearly all the cotton raising area and had become the leading insect pest of the United States, perhaps of the entire world. In 1907 it did 25 million dollars worth of damage, and eventually forced the abandonment of the cultivation of number one "Sea Island" cotton in the coastal districts of South Carolina, Georgia, and Florida.

In the state of Washington about 200 economically important species of beetles are known, about half of them agricultural pests, a quarter of the remainder are household and stored food pests, and the rest are forest and timber pests.

* * *

Paradoxically, the first recorded notices of beetles by man were not of an economic nature. In ancient Egypt the dung-rolling scarab (*Scarabaeus sacer* L.) became sacred to the sun-god. The ball of dung was likened to the sun, and the beetle itself was mumified. Stone "scarabs" carved in a rough likeness of the beetle's image are known from the VI Dynasty (2700 B.C.), became common with the XII Dynasty (2100 B.C.), and continued in use nearly to the end of the native rule.

The first scientific notice of beetles was by the great Greek philosopher and zoologist, Aristotle (384-322 B.C.).

The common names for beetles in nearly all languages stem from their biting and running qualities, than which hardly any features are less characteristic. The genius of the Stagerite led him to detect and select the sheath-winged condition as their definitive feature, and he coined the term "Koleoptera," "sheath-wings," which we still use. Aristotle mentioned only three examples of his "Koleoptera," and his successors for 1900 years hardly did more than double or triple this figure.

With the birth of Western European science, however, the curiosity of mankind concerning the "sheath-wings" no longer brooked such easy satisfaction. The sixteenth and seventeenth centuries saw a gradual increase in knowledge, and the great folio volume of 1602, *De Animalibus Insectis*, by Ulysses Aldrovandus of Bologna is the chef-de'-oeuvre of the movement. Here about 90 species of beetles were described and figured.

The eighteenth century was the classical period of man's increasing awareness of nature. The age of geographical discovery had brought to light strange forms from all portions of the world, and cabinets of natural history became as common and as respectable as has stamp-collecting in our own day. Even kings joined in the sport of garnering in specimens of minerals, plants, and animals from far and near. About this time too, somebody discovered that the larger insects could be preserved by impaling them on needles and kept in drawers or boxes.

In response to this situation, the Swedish naturalist, Linnaeus, essayed the task of preparing a compact *Systema Naturae* to the three realms of nature, minerals, plant, and animal, and the present phase of beetle-study dates from the 664 species of beetles

briefly and precisely defined and named in the 1758 edition of the zoological portion of Linnaeus' work. Linnaeus did not realize that he was not writing the definitive work on the Animal Kingdom, and that less than two centuries would see the beetle portion of his book alone increased by at least four hundred fold!

The modern study of beetles, then, is less than two hundred years old. The first of these centuries, that from Linnaeus to Darwin was the classical century. In the main, too, it was a French century, for while the early work of Linnaeus and his immediate students was scandinavian, the greatest and culminating work was French. Men discovered that it was not necessary to go to the far ends of the earth but that nature's treasures were teeming in field and forest, pond and shore, at their very door-steps.

The joy and excitement of beetle-collecting must be experienced to be fully appreciated; the freshness and the beauty of the countryside, the exhilaration of the physical exertion, the continual gamble that each new stone or hedgerow will reveal some unexpected rarity, the scientific interest of studying these complex insects, the satisfaction of seeing one's collection of these living jewels grow under one's hand. I have felt it in myself and seen it in my colleagues and students. What must it have been 150 years ago when the science was new and my day's collecting anywhere might reveal novelties!

The motif of the period is perhaps revealed by the career of the Count Dejean, Peer and Councillor of France³. Auguste Dejean was born at Amiens in 1780. At the age of 13 he decided to

give his life to the collection and study of beetles. Two years later he was carrying a musket for the republic. He rose to be general of a division and Aide de Camp to Napoleon, and acquired both power and riches that survived the fall of the Empire. But he never wavered in his search for beetles. His soldiers called him the French equivalent of the "bughouse general." While under fire in one of his battles he spied a specimen of *Cebrio undulatus* on a flower. Dismounting, he bottled it only to have the bottle shattered an hour later by a stray shot. Thereupon he dismounted a second time and searched until the beetle was recovered! Before his death Dejean had amassed a collection of over 22 thousand named species of beetles, than which few private collections have ever been greater. The published catalogue (1837) of his collection was practically equivalent to a world-catalogue of the then known species.

What a Peer and Councillor of France could do in the grand style, dozens of others repeated on a less liberal scale. The French entomological society was organized. The Paris museum gave governmental sanction to the work, and as individual collectors died or grew tired of their collections, the museum acquired their holdings until today it possesses the largest collection of beetles in the world, 500,000 boxes. The century of French ascendancy closed with the publication of Jean Theodore Lacordaire's *Genera des Coleopteres*, (1854-1876), in twelve volumes in which the effort was made to give an account of every known genus of beetle. No one has attempted such a work again.

The second century of the modern study of beetles was with the Germans; and the German studying beetles is certainly a more pleasing expression of

³ Dow, Bull. Brooklyn Ent. Soc. IX, 1914, pp. 10-18, 27-38.

Teutonic genius than the sadistic madness of National Socialism!

The first requirement of mid-nineteenth century coleopterology was a more adequate method of analysis. The earlier method of treating the species under a genus was to attempt to describe each of them in mutually exclusive terms. Thus, one had to read each of the descriptions one by one to determine where a new specimen might belong. This situation was remedied by the construction of analytical "keys" which, by a series of dichotomies, each involving only a single pair of alternatives, led one to the placing of his specimen. First in 1849 we find this method applied to an entire beetle fauna in Ludwig Redtenbacher's *Fauna Austriaca*. It is now the method of presentation of a large segment of coleopterological and other zoological work.

Then there were the great German catalogues: the *Catalogus Coleopterorum* of Gemminger and von Harold, twelve volumes, 1868-1876, listing 77,000 species of beetles; and the Junk-Schenkling *Coleopterorum Catalogus*, 1910-1940, in 31 volumes, nearly 25,000 pages, listing about 215,000 species of beetles with full bibliography of each.

Perhaps the most acute of the German coleopterists was Georg von Seidlitz (1840-1917), who as early as 1875 in his *Fauna Baltica* employed most of the subdivisions of the beetles as now recognized by those who seek to work out the evolutionary relationships of the order.

Nearly every country of middle Europe from Italy and the British Isles to Scandinavia and Roumania had its beetle-fauna worked out, frequently in richly illustrated detail, and the most comprehensive single volume on beetles so far to have been produced is Paul Kuhn's, *Illustrierte Bestimmungstabel-*

len der kafer Deutschlands (1913), which in 1138 pages and 10,350 figures, provides an analysis to the adults of more than 6000 species as well as a host of larvae. Indicative of the direction beetle studies are now taking is the projected 30 volume work on the beetles of the U.S.S.R., in the *Faune de l'URSS*, announced by the Russian Academy of Science in 1941, but of which only three or four volumes have appeared.

Outside of Europe coleopterists have been too few to do little more than chip away at the vast numbers of forms awaiting discovery and description. In North America, the northeastern states, north of the Ohio River, have been most adequately explored; but W. S. Blatchley's *Coleoptera of Indiana* (1910) is the only complete faunistic work on the beetles that any American worker has had both the energy and temerity to produce. The student of the North American fauna north of Mexico has a key to genera in J. Chester Bradley's *Manual of the Genera of the Beetles of America North of Mexico* (1930). He has a catalogue and partial bibliography in Leng's *Catalogue of the Coleoptera of America north of Mexico* (1920) with its four supplements, the last one dated 1939; and he has a guide to some of the basic literature in the present author's *Indices to the lists of and keys to Nearctic beetles* published in 1927 and 1928 with *Supplements* in 1929 and 1941⁴.

With regard to the world as a whole, however, the new species are being described more rapidly than they are integrated into the existing system, and Dejean's century-old vision of a world-wide comprehensive work on the beetles is farther from realization than

⁴ Jour. N.Y. Ent. Soc. XXXV, 1927, pp. 279-306; XXXVI, 1928, pp. 335-354; XXXVII, 1929, pp. 135-143; LIX, 1941, pp. 21-42.

ever. Eventually, it would seem, a new synthetic book on the beetles of the world will be attempted, but with species by the hundred thousand still awaiting discovery, the appearance of such a work is likely to be long delayed.

The phase of the beetle-human relationship that we have just described was, then, a development of eighteenth century natural history. If it has not yet run its course, it is because of the extraordinary complexity of the issues raised. Its basic motives were, however, relatively simple: a delight in the form of habits of living things and the need, arising from their multiplicity, to classify them if they would be enjoyed. The classification developed first theological, then evolutionary, and now economic implications, depending on the overall outlook of the period involved, but these were excrecences rather than basic factors, so far as this aspect of the beetle-human relationship was involved.

* * *

The leading scientist of the eighteenth century was not, however, Linnaeus, but the great Frenchman, Antoine Lavoisier. Through the experimental analysis of combustion, Lavoisier established the science of chemistry and paved the way for man's increasing control of nature in the fields of physiology, medicine, and agriculture.

It has already been told how, since early times, beetles have been nibbling away at man's crops and man's possessions. As the nineteenth century advanced, this depredation was subjected to increasingly penetrating experimental examination. At first relatively ineffectual substances like kerosene and white-wash were all that the experimenter had at hand, but towards the end of the century some of the

arsenicals began to give a really effective control of certain species. It was paris-green, for instance, that about 1865 first made potato culture possible in the presence of the Colorado potato beetle. And in our own century an increasingly specialized series of insecticides, inorganic and organic, has been made available. The pea-weevil, for instance, a serious pest of both growing and stored peas, has been effectively controlled in our own day by the use of rotenone and related substances obtained from the roots of various tropical plants.

At best, however, insecticides establish but an uneasy equilibrium in man's favor, and the insect is always prepared to reassert itself when the controls are relaxed. Every season, on schedule, for instance, the potato grower in affected areas must spray his potato plants, and one of the leading flour mills in Seattle is permanently piped for periodic fumigation with hydrogen cyanide gas against the moths and beetles that infest the plant. In fact, even the coleopterists own beetle collection is maintained free from carpet beetles (*Anthrenus*) only by periodic treatment with paradichlorobenzene or creosote.

Despite the fact that most insect control is of this temporary sort, the goal of at least a portion of economic entomology is the discovery of procedures that will so alter conditions that the injurious insects will be unable to develop. Forestry operations, for instance, are sometimes carried on in the presence of the beetles that feed on dying trees by cutting the logs before or after the egg-laying period of the beetles and by utilization of the felled timber that gets it sawed and to market before the beetles have a chance to do any injury. The day of the carpet beetle and the clothes moth would be

speedily over if the chemical industry could introduce either a plastic substitute for wool and hair in our clothing and household furnishings, or a method of permanently and harmlessly moth-proofing the same.

In contrast to the chemical control of insects, success sometimes attends the effort of the entomologist to introduce biological enemies of an injurious species. The aim of such work is not to exterminate the pest—this is rarely achieved—but so to reduce its numbers as to make it unimportant. Most of the successes in this line of endeavor have been on oceanic islands, where the habitat involves few competitors and is biologically relatively simple. Among the beetles so controlled, at least in part, may be mentioned certain sugar cane pests in Hawaii (*Rhabdonemis obscura* Boisd., Curculionidae, and *Anomala orientalis* Waterh., Scarabaeidae,) and Mauritius (*Phytalus smithi* and *Oryctes tarandus* Ol., Scarabaeidae). The first of these were controlled by introducing a parasitic fly (*Ceromasia spenophori* Vil., Tachinidae) from the Dutch East Indies and a predatory wasp (*Scolia maniliae* Ashm.) from the Philippines. The beetles in Mauritius were partially controlled by a couple of predatory wasps, one (*Tiphia paralella* Smith) from the Barbados, the other (*Scolia oryctophaga* Coq.) from Madagascar.

On the other hand, beetles have sometimes themselves been imported to control other insects. In 1888 and 1890 an Australian ladybird beetle (*Rodolia cardinalis* Mulsant) was introduced into southern California to control the cottony cushion scale (*Icerya purchasi* Mash.) that was threatening the citrus

industry with extinction. So potent are these beetles that they literally eat up the last scale in the vicinity and then starve to death, so that a supply must be maintained in the insectary with which to combat new outbreaks. This species is now employed throughout the citrus growing world to control this particular pest.

Partial control of the citrus mealybugs (*Pseudococcus* spp.) is obtained in California by means of two other ladybird beetles, one (*Cryptolaemus montrouzieri* Mulsant) introduced from Australia in 1892, the other (*Scymnus binaevatus* Mulsant) introduced from South Africa in 1921⁵.

Contrariwise, however, efforts to employ some of the native ladybird beetles (principally *Hippodamia convergens* Guer.) in the control of plant lice are not successful. The beetles actually do consume plant lice in large number, and around 1915 were being transported by the ton from their hibernation places in the California mountains to the irrigated fields. Investigation, however, showed that the beetles scattered so rapidly upon being released in the lowlands as to have no appreciable effect on the plant-lice! Distribution of the beetles was, accordingly, suspended by scientifically responsible agencies, but has been continued on a small scale by individuals in California and on a small commercial scale in Washington even to the present time.

Wheat, rice, potatoes, citrus fruit, cotton, wool, furs, lumber—the importance of these items in the life of man is a measure of the place of the beetles in human economy.

⁵ Data on biological control mostly from Imms, Recent Advances in Entomology, 1930, pp. 317-337.



*A War Time View of Some European Biological Stations**

By

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While I was engaged with a special mission to Germany for the War Department, April-August, 1945, it was my good fortune to visit a number of biological stations and laboratories in England, Germany, and Austria. In a running account, I should like to brief you about these contacts and list the publications I collected. These papers and books, some of which you may not have seen were printed during the war. It is my hope that some of these incidents and papers will bring you in touch with colleagues abroad who are working on projects which impinge upon your own research.

The first scientist whom I visited was the well known British ecologist, Charles Elton, in charge of the Bureau of Animal Populations, Oxford, England. During the war his entire staff was studying rodent populations and methods of exterminating them. They had been able, for example, to reduce the rat population of the sewers of London and the wharf area by 95%. The technique was quite simple: pre-baiting for five days without poison, then adding the poison the sixth day. Experience with governmental bureaus during the war had brought Elton to the conclusion that in order to remain happy in that work one must keep an

idea ahead of the federal director all the time—"Don't get into the position," he said, "of letting him tell you what to do."

Zoologisches Institut, Munich

In the ruins of the Zoologisches Institut of the University of Munich I found Professor Werner Jacobs who had been released from Wehrmacht duty on the Russian Front a year before. Those of you who have been interested in fish physiology will recall the classic series of papers he published in the *Zeitschrift für vergleichende Physiologie*, 1930-34, on "Untersuchungen zur Physiologie der Schwimmblase der Fische" in which he brought forward a great deal of evidence that the Physoclisti adjust the pressure of the swimbladder by gas secretion and absorption, while many Physostoma swallow air into the bladder in addition to having a gas-secreting gland.

Recently Professor Jacobs and his students have been working on the hydrostatic function of respiratory organs in aquatic animals. They have shown that the lungs of frogs and turtles serve to alter the specific gravity and aid them in floating and swimming. In a review article (1943) he discusses the entire problem of specific gravity adjustment for aquatic animals—I commend it to all biologists. (See list of papers.)

Priv. Doz. F. Peter Moehres has done some interesting work in conjunction with a Dutch worker, S. Dijkgraaf, on the importance of the Weberian appar-

* An address given on Dec. 6, 1945, before Zeta Chapter.

atus of fish in the perception of pressure changes. Moehres has applied the principle of pressure perception to its role as an ecological factor in the life of fish in an attempt to analyze the reasons some fish habitually take up definite positions in the water, e.g., surface, pelagic, bottom fish. John Neess has abstracted his paper "Untersuchungen über die Frage der Wahrnehmung von Druskunterschieden der mediums." Z.f. vergl. Physiol. 1940. It will appear in Biological Abstracts.

Incidentally Moehres and Dijkgraaf have been investigating the sensory physiology of bats and, quite independently from the researches of Griffin at Harvard, came upon the use of super-sonic projection of bats to locate and avoid objects in the dark.

The director of the Zoologisches Institut, Professor Karl von Frisch, was forced to move to his summer cottage near Salzburg when his residence in Munich was completely destroyed. Because he thought the Munich residential area would not be bombed he had moved his library to his home. Thus one of the finest libraries in sensory physiology was blown up. The Zoologisches Institut was built for v. Frisch by Rockefeller and was one of the most modern zoological buildings in Europe. Only the basement and first floors are undamaged; the rest of the building is badly gutted. K. v. Frisch and his students pried into the problems of the sense of hearing in fish and established the range of sound differentiation by *Phoxinus* and discovered that the sense of hearing disappeared when the lagena was removed. He has worked extensively on sense of smell, color changes in fish, and was the discoverer of the "Schreckstoff," a secretion from injured skin of *Phoxinus* which, in extreme concentrations, is perceived by schools of this minnow

who are alarmed, and seek cover. You may be interested in my visit with v. Frisch when I saw him the first time at his field laboratory and summer home near Salzburg, Austria:

Professor Karl von Frisch, famous zoologist of the University of Munich is a man whom I have admired for several years because of his outstanding research on the sensory abilities of fish, bees, and some other animals. When I called on him at the University of Munich I was informed he had left there to live at his summer cottage which he had converted into a field laboratory for himself and assistants because his own home had been ruined by two bomb hits. The assistant director of the *Zoologisches Institut* in Munich gave me a letter to take to him when I reached Salzburg. This I did—it was the first news he had received from the Institut since before the surrender.

We drove through the quaint little village of St. Gilgen, inquired for Brunnwinkl, drove down a narrow road along the beautiful St. Wolfgangsee, and admired the angular, wooded mountains that shot up several hundred feet around the lake. We parked the jeep at the top of the hill where a path led down to the lake's edge. There we saw some old Bavarian-type houses, walked down to them and inquired for Professor von Frisch. His wife took us out to him where he was busy at work under a little shelter, continuing his observations on food location and the means of communicating it to the bee hive by the bee that found it. He was watching a colony of bees in a glass case as they swarmed over the large enclosed cone. Here and there among the mass of bees were individuals with 1, 2, 3, 4 or 5 different colors daubed on the thorax. He was watching them, counting and pushing a stop

watch. As he observed, in between counts he proceeded to tell us about the experiment. It happened that the bees were feeding at a sugar feeding station 700 yards away; after we finished the observations I walked over the hill to the station (a 15 minute walk) where his laboratory aid sat with her paint sticks marking the bees as they lighted on an elevated platform on which was a shallow watchglass of sugar water. The work, he proved to me, has shown that the bees find this feeding station and return to the hive to notify their co-workers who get the scent and fly to the site. To notify his colleagues, the bee makes two types of dance: the "Rundtanz" and the "Schwänzeltanz." When the "Schwänzeltanz" is done, the bee goes around in a circle and wiggles his hind end; he makes these rotations at different rates depending upon the distance the food store is from the hive. The farther it is the slower the rotations. The bees at that moment were rotating five times in 15 seconds which he said was characteristic for that distance. It was strange to see these bees fly in the hive door, get among the bees and begin the dance. The colored dots on the thorax gave the experimenter the identification number of the bee. The colors can be arranged so he can mark up to 499 different bees. It impressed me to see a man doing such fine work with no equipment except a stop watch, a hive of bees, sugar water, and paints of five different colors.

Professor von Frisch is a round-faced, grey-haired man of slight build who wears glasses and is about 59 years old. A gentle humor, quiet manner and clarity of explanation and thought, characterize him. I made several visits to Brunnwinkl so got to know him well. He is continuing his research

with what vigor one can muster under limited food intake.

His story during the war is as follows: Because he had a non Aryan grandmother he was to have been released or retired from his professorship. Also he was a pronounced anti-Nazi from the beginning of the war. His forced retirement was countermanded, however, because it was learned the Russians had discovered that his experiments on bees could be applied to agriculture; they got such good honey yields that the Nazis decided von Frisch could be of service to them, so they postponed his dismissal until after the war and gave him a grant of research money to continue this important work.

The technique the Russians applied was the part where he was able to train bees to note the scent of a flower and communicate this scent to the workers in the hive. That is, one could dab a flower into sugar water, carry it to the hive, let the workers catch the scent, and they in turn would fly in search of this flower (a clover field for instance). Soon the whole gang would be notified and the collection of nectar would begin. The Russians used this system (gave von Frisch credit for the idea in their publication) to increase the honey collection by 50% over control bees. Von Frisch has been able to increase the seed production of red clover and other crops by inducing the bees to concentrate their flights on clover fields. The Russians used a flower of a crop called "Zottelwicke" (*Vicia villosa*); not only did the honey collection increase, but the fertility of this crop increased, because more bees came to carry the pollen around from flower to flower.¹

¹ I have prepared abstracts of two of his recent articles. They will appear shortly in Biological Abstracts.

Wielenbach

Unfortunately, I was unable to arrange a visit to the Anstalt für Fischerei at Wielenbach bei Weilheim although I was very near when in Munich. (All of these excursions were on weekends and in evenings, and only incidental to my job with the army.) You are all familiar with the research on a large series of carp ponds there and the results which have been published chiefly in the *Handbuch der Binnenfischerei*.

University of Innsbruck

At the University of Innsbruck I was able to see a good deal of Professor Dr. Otto Steinböck, Alpine limnologist and ecologist. When I left there he presented me with Ruttner's new book on limnology, *Grundriss der Limnologie*. I had been unable to buy it in any of the few stores that were still intact. (I commend this concise treatise to you.)

It was not possible to bring reprints of all Steinböck's papers, but a few of them are noted in the bibliography. The *Zoologisches Institut* at Innsbruck was hit twice with bombs and one assistant was killed. Steinböck had personally repaired some of the walls and the roof so that work could be continued. Some rooms were blasted away; the building looks like a rectangular cake from which a piece had been cut.

Steinböck has published several papers about expeditions to Greenland, and, incidentally, found *Planaria* living there in some hot springs. He is currently working on the limnology of an Alpine lake of such high altitude that it is only free of ice two months of the year—September and October. The trout in this lake are stunted but grow when brought to the laboratory, warmed, and fed well.

The following is the story of my field trip with Professor Steinböck to the Sulztal glacier. Professor Stein-

böck and I motored along the Inntal toward Oetz in a drizzling rain. We picked up some GI's enroute, and dropped them off just as we went up the Oetztal. It stopped drizzling by the time we got to Längenfeld; there we branched off on a narrow, winding road up the mountain side and into the Sulztal; from there we went to the last village, Gries, at the head of this valley (more like a canyon). Along the road we could look back from time to time into the valley below and see the picturesque village, a spire of a purely Gothic church towering from the center of the village into a light morning mist. The village was encompassed by green fields of hay and grain. On each side of the valley, as we approached Gries, were cultivated fields reaching almost to the vertical walls of the U-shaped glacier-formed valley. At the edge of these fields fir forests stretched up to the timberline. In this little village, which looked so very poor, we found a "Gasthaus." The "Wirt" was all dressed up for church. After a friendly exchange, and a tip of cigarettes, he let us store the jeep in his barn for the day.

From this little village we went out to worship Nature as biologists. The hike began. We trudged along for two hours before passing the timberline. By this time the skies had cleared and we had hopes for a beautiful day. Just over a little rise we came upon a wooden shack on a meadow (Alm). In the shack a Tyrolian was cleaning up some kettles. Over a fire was a large copper caldron full of milk—it was being kept warm, rennin had been added, and the cheese making process was under way. Amid all of the primitiveness of the shack was a modern Sharples cream separator. We traded some cigarettes for a glass of milk—my first fresh milk since leaving the

States. On up the valley we climbed, passing these little "Alme." The professor told me how the grass was scythed in the fall and stacked inside the little wooden log shacks (Heu Hütli). The sides of some of these "Alme" are so steep the farmers must use spiked shoes to keep their position while they swing the scythe. In winter, after the cattle and sheep have been taken into the village, and after the first snow, the "Bergbauer" climb up to these little "Hüte," load the hay on a sled and whiz down into the valley, a dangerous ride, equal in daring any day to parachute jumping.

After another half hour we turned onto the last "Alm" and there was a beautiful stone building, a hostel, "Armberger Hütte," for hikers of the "Deutsche-Alpenverein." We were able to have our K ration coffee warmed by the innkeeper, so we had an 11 o'clock lunch within an hour's hike of the Glacier. I thought to myself how wonderful it was to be high up above timberline, where we could feel the cool breeze off the glacier and look up at the perpendicular, bare cliffs so far from war. But not 100 yards from the "Hüte" were three large bomb craters and bits of bomb fragments. Beyond, and on the glacier, we found small strips of tinfoil, "window," that the fliers had thrown out to distort radar detection.

As we passed our first snowbanks we saw little lavender bellshaped flowers poking their heads right through the edge of the snowbank. Here the early spring was in evidence. Other Alpine flowers were pointed out to me as Steinböck knew them all. I enjoyed their beauty and admired their hardy adjustments to this rugged life. After another hike through and around rough rocks we came down upon the ice of the glacier. In spots it was covered with

snow. Dr. Steinböck then showed me some tiny insects, the glacier flea ("Gletcherfloh"), *Isotoma saltans* (Collembola), making jumpy black dots on the ice and snow. He told me of his studies that show they inhabit the crevices of the ice, live and lay their eggs there. Their food is largely pollen. He found that their optimum temperature is 2°C. They attain amazing population densities of 10,000 sq.m. We saw several Alpine birds and mammals.

When we got back to the Hütte we were hungry enough to eat again, which we did. Near the Hütte was a tiny Alpine pond, in which were redbellied salamanders. I picked up a black cheeked frog nearby, Caddis flies and Planaria, Steinböck told me about a little "Tümpl" (pond) nearby where he had studied *Planaria alpina*. He found that it tolerated warm water (some days the water get up to 28°C.) which the same species cannot do at lower altitudes, and cannot tolerate in the laboratory. Also, that it crawls along the surface of the water exposed to the strong rays (ultraviolet is much stronger at these altitudes) of the sun. Again, a behavior which it does not have at lower altitudes, for there it does not like light and crawls under the stones.

Under laboratory conditions incidentally, the Alpine form is also negatively phototactic. Why?

Steinböck informed me that Woltereck had died during the war. You will recall that Woltereck worked for a year at the University of Wisconsin.

Lunz, Austria

I was not able to visit Dr. F. Ruttner, Director, Biological Station, Lunz, of the Kaiser Wilhelm Gesellschaft, but learned he was well and had been active during the war.

*Institut für Seenforschung
Lake Constance*

My visit to the Institut für Seenforschung of the Kaiser Wilhelm Gesellschaft in Langenargen am Bodensee (Lake of Constance) was short, consisting of only one Sunday. The laboratory was very disrupted because French occupation troops were housed there, e.g., one had to walk around the cots in the chemical laboratory to see the equipment. Dr. H. Elster, Director of the Institut, was in military service and probably a prisoner of war of some allied group. Dr. W. Nümann, Resident Biologist, was very helpful, explaining without reticence the objectives of the laboratory and the results they were getting. Swiss, Austrian, and German fishermen depend on this station for technical advice, as does the International Committee which regulates the Bodensee fishery. Dr. Hildegard Maschlanka is Algologist and assistant to Professor J. Hämmerling (who was ill at the time of my visit but who had been active in research). The latter two had just returned from a Mediterranean Station at Rovigno where they were studying marine algae during the war.

Current research at the Institute für Seenforschung was directed toward determining strength of year classes in Coregonids which compose the major commercial fishery), the best gill net mesh sizes for the proper conservation of the fishery, and also the efficiency of planting—following up some of the leads about survival of hatchery raised Coregonids which had been suggested by Dr. Einsele in the Salzkammergut lakes (see below). Nümann is also continuing observations on seasonal migrations of various species similar to those in his 1940 paper, especially the relationship of the migrations of one species to another, in addition to

studies on the commercial desirability of certain species, i.e., which species should be encouraged, which reduced in numbers in the light of which were of greatest value to the fishermen.

*Reichsanstalt für Fischerei,
Weissenbach am Attersee*

Dr. W. Einsele, Director of the Reichsanstalt für Fischerei, Weissenbach am Attersee (Salzkammergut, near Salzburg), is about 42, 190 lbs., 5' 10" and looks much like a husky Dane or Swede. He was a student at Columbia University, worked with Dunn, the Geneticist; consequently he speaks English fairly well as does his charming wife. Dr. Einsele refused to join the Nazi party, but like many valuable scientists he was not removed from his post because of manpower shortage. I checked with the local military authorities and found that he had been cleared as thoroughly reliable. In fact, they were using him as the official translator for the area.

The buildings of the Anstalt are occupied by displaced persons, as the laboratories at the Institut am Bodensee were occupied by French troops. The boats have been appropriated by the soldiers for pleasure use; consequently, research at the present is at a standstill. Dr. Einsele's story proved, however, that their work had gone along throughout the entire war in spite of the loss of personnel. Every assistant he had at the outset of the war was killed in battle. Women and professional fishermen on the lake had replaced them to carry out the field work and continue the experimental hatchery. His publications were dated as late as 1944 as proof of the productivity of his station.

Snuggled at the base of a steep cliff at the Salzkammergut mountains, only a stone's throw from the edge of the picturesque Attersee, lies a little group

of buildings of typical Bavarian-Austrian Alp architecture. From the second floor extended the typical artistically designed wooden verandas. As a unit they fit characteristically into the landscape of the "Vorgebirge" of the Alps. Attersee is about the size of Lake Mendota, but is long, like Lake Geneva. It reminds one somewhat of the setting of Devils Lake in the Baraboo range, except that the foothills are chiefly hay fields and the mountains are more wooded. Exposed cliffs show stratification of sedimentary limestone rock similar to some parts of the Rockies, indicating their origin in an ancient ocean.

Dr. Einsele's researches have been directed toward the analysis of the success of natural and hatchery production of indigenous races of Coregonids. The problem is similar to ours in the States, namely, that hatcheries have been producing millions of fry under the assumption (unproved) that the fertility of eggs in nature is poor and can be improved upon in the hatcheries. As in the States, they have shown that the fertility in nature is high, but that *mortality* in nature, after hatching, is also great. They have shown, moreover, that the release of millions of fry into lakes has had no beneficial effect upon the commercial fishery. The fishery is regulated by the Government much as the State of Wisconsin regulates the Lake Michigan fishery. (There is very little sport fishing, except what the GI's do with the hand grenades. Most of the little streams feeding these lakes have been cleaned out of all species including their fry. Director Einsele did not believe the headwaters had been reached, so he hoped that it would "re-seed" in time.)

One of Dr. Einsele's students followed the year class of hatchery raised Coregonids (in the Bodensee) which

were introduced as fry at a density of 100 per hectare. There was no sign of increased production in the years following as this year class of fish should have reached maturity. Wagler, in a monograph on Coregonids in the 1941 issue of *Die Binnenfischerei*, gave figures on the productivity of the Bavarian lakes. The maximum computed from the old records was 75 kilogram per hectare yield per year. In recent times 10 kilogram per hectare was the greatest yield. In the Salzkammergut lakes, on the other hand, 0.5-1.0 kilogram per hectare per year has been a good yield.

Einsele's group is also concerned about mesh sizes, age of maturity, etc., of the fishes in the lakes in order to establish the correct cropping policies and to uphold the maximum that "every fish should be given the opportunity to spawn at least once"—regulating fishing gear accordingly.

Some of their records and computations of success of hatching in nature when compared with capture, show that less than 0.001 per cent of the Coregonids hatched (Bodensee) reach the fishermen's nets. In an attempt to determine reasons for the low survival, Einsele attacked the problem from a number of angles:

1. What causes the high mortality of young Coregonids in the first year of life?
2. What size fingerling (hatchery raised) has the greatest possibility of survival?
3. What races of Coregonids are most hardy?
4. Can Coregonids be introduced into non-coregonid lakes, or can one race be introduced successfully in competition with an endemic form?

(He has used a race of Coregonids whose gill-raker count averages 25 (21-31), and differentiates between it

and the endemic form which has 45 (39-50), i.e., he has a natural "tag.")

Hatchery experiments have shown that if white fish are hatched and presented with food directly available from the lake, as plankton, they starve in a few days. At their normal hatching time the plankton concentration is only three organisms per liter. If however, plankton nets are used to collect additional plankton for the fry, then the mortality decreases. In rough terms, if one increases the food density 100 times, he is able to increase the survival proportionately. Large plankton nets four feet in diameter are towed from a boat, three h.p. outboard motor. The feeding procedure was about as follows:

The plankton organism is caught individually by the fry. Contrary to popular beliefs Einsele thinks that even the large Coregonids capture each plankton individually instead of filtering. Size of plankton organisms is an important factor, i.e., whether Diaptomus, Cyclops, Bosmina, or Daphnia are abundant at the critical period. Moreover, the light intensity appears to be an important factor. In experiments where the light concentration is only three lux the fry starve to death in a short period in spite of adequate food, but all survive when the light intensity over the troughs is 15,000 lux. There is a possibility that many fish perish if the season is long and the ice is snow covered—they can't see to eat.

The local commercial fishermen helped in some of the experiments and gathered plankton with huge cone nets, collecting every day in spite of weather during the months of March to May. They would collect as much as 1500 cc. wet volume per day of zoo-plankton; enough to feed 100,000 fry. One thousand fry should get 15 cc. of wet vol-

ume plankton per day, or, at 10°C. they should receive one cc. plankton for every gram of fish.

In tanks, the optimal density of fry is 10 per liter; in ponds it is 2-5 per liter. Food is given as above or 50-500 times the concentration of the normal lake water at that season. The fish weigh about 10mg. each when two weeks old. Fish at 20mm. in length eat about 500 plankters a day; at 30mm. 1000 per day.

Best success has been had by raising the fry to a fingerling size of 25-30 mm. Sometimes the hatching time is delayed by cooling the water so that they will reach this size at a time when the lake conditions are more favorable, i.e., when the food density is greater than in March. In one lake they introduced 10,000 fish 28 mm. in length (1940). In 1942 they began to get into the fishermen's nets. By 1944 they had recovered 1600 adults.

Some races have been studied which are more hardy than others. The fry seem to be more energetic in finding food, or learn to find it faster. There is a difference in the types of food they select. Again the spawning time of the races varies. It may be possible to introduce a form whose fry hatch at a period when the plankton conditions are most favorable—therefore such a race might be more successful than the indigenous variety.

In lakes where Coregonids do not occur they feel that some may be planted in order to use the large stores of plankton that are otherwise wasted.

This group is very critical and they are aware of the many problems and are not going all out for any of these ideas without thoroughly testing their theories.

Fertilization with phosphorus has been practiced in a small lake. The results look very good. Production of

plankton was increased. Undesirable species, as in Lake Monona, were not a problem.

Einsele is a good chemist. He has done high grade chemolimnological work concerning iron, manganese and phosphorus. (See literature.)

Plön

Although I did not visit Plön I learned Thienemann was well and his "Institut" intact. Most of his building was used by the government during the war for marine research. Thienemann was much inhibited from lack of staff and assistants. Incidentally, undamaged universities in western Germany are: Gottingen, Tübingen, Erlangen, and Heidelberg. The following notes on damaged or destroyed universities are incomplete. They are: Munich, Innsbruck, Würzburg, Bonn, Cologne, Leipzig, Vienna, Münster (completely), Darmstadt (Technische Hochschule), Halle.

Freshwater Biological Association of the British Empire

Upon returning to England in August, I spent five days at the Freshwater Biological Association of the British Empire which has leased Wray Castle on Lake Windemere and converted it into a combination dormitory-laboratory. I was fortunate to be there when the station's director, Dr. E. B. Worthington, was in residence. (You will know him for his work on African lakes.) He had just returned from a long mission for the British Government, coordinating scientific research in the Middle East. Worthington is an energetic man of about 42, with a very optimistic view for the future of limnology in the Empire. Apparently the British Government is realizing the value of aquatic research and intends to expand the number of laboratories and research projects in the colonies as well as on the islands.

Plans are not concrete but were pointing up. Apparently the role of freshwater fishes in relieving the protein shortage among colonial natives is significant and worthy of support. Worthington mentioned that Palestine Jews had taken up carp farming and were producing 1000 pounds per acre of carp-aided, of course, by an especially long growing season.

Dr. C. H. Mortimer was still in war work, but was expected to be released shortly. I was sorry I could not see him to learn more about the use of echo sounding for lake mapping. He did a remarkable job of sounding Lake Windemere with such an outfit mounted on a launch. This outfit looks very promising for sounding thousands of lakes in Canada and this country. If one had an echo sounder mounted on any "duck" vehicle the possibilities would be great.

In addition to sounding the bottom accurately the record of the echoes indicates the nature of the bottom sediments and the location of weed beds. In fact it has been used during the war in marine work to locate kelp beds. It has application in reservoirs to determine the rate and location of sedimentation.

Miss Winifred Frost is continuing work on the eel and is also beginning a project on northern pike. Lake Windemere has a tremendous population of very large pike which have not been utilized by the sport fisherman. Most of you have seen her recent work on the life history of the Minnow, *Phoxinus*.

E. David Le Cren, a promising young scientist, has been the main stay of the perch program. He has ready for publication a careful study of perch and growth in addition to its management in Lake Windemere. Incidentally he uses the opercular bone for aging perch

and finds it much easier to read than scales.

The perch fishery in this lake has been exploited commercially during the war to aid in relieving the food shortage in England (they were marketed in tins as "perchines") and also to reduce the perch population to a point where the average size of the perch would increase. After four years of intensive fishing to the point where it did not pay to catch them commercially he found no appreciable change in the average size. There is no tenable theory as to why. LeCren has tagged perch to study migration and finds some evidence of a homing instinct.

Metal funnel traps have been more effective in catching perch in Windermere than gill nets. Two men could service about 100 traps in a day. The big catches are seasonal, April-June, and consist largely (2/3) of males.

Dr. J. W. G. Lund, a promising young algologist, has just joined the staff and will pursue researches in ecology of the planktonic algae.

Dr. S. P. Chu, Chinese algologist was visiting at the station; he has been successful in culturing some blue-green algae and determining, as you know, their nutritive requirements.

Cambridge University

At Cambridge, I had a good visit with

H. C. Gilson who led the 1937 Percy Sladen Trust expedition to Lake Titicaca. During the war he was working on blood plasma preservation.

Margaret Brown, a new doctorate at Cambridge, had done some interesting work with brown trout under controlled laboratory conditions, i.e., when brown trout were exposed to constant light intensities, and lengths of exposure that the spawning season was not different from those in nature.

Under controlled temperature and food, she noted that there was an autumn cessation of growth in brown trout and a rapid spring spurt. Incidentally she observed some interesting phenomena in social hierarchy in aquarium societies of brown trout. All of these observations will be forthcoming in a detailed publication.

In London I saw Mr. Wigglesworth and his laboratory of insect physiology, but this report is too long to give details. He had just returned from a tour of the States and Canada, and was in the throes of moving his program to Cambridge University.

The following is a selected list of papers and books which appeared during the war. They are listed here because there may be some delay before they are available in this country.

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Chapter News Letters

Zeta

—University of Wisconsin

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During the fall semester Zeta Chapter has achieved a rapid recovery after several years of moderately reduced membership. While regular meetings were held, the number of active members curtailed large scale activities. Three lectures have highlighted the fall program.

Dr. J. H. Mathews, Professor of Chemistry, presented an illustrated lecture on "The Use of Scientific Methods in Criminal Identification." Among the topics which were presented were the identification of guns from fired shells, the identification of edged tools from the marks they leave, the restoration of filed serial numbers, the use of infra-red and ultra-violet light in criminal identification, and the theory and applications of the lie detector.

Dr. A. D. Hasler, Professor of Zoology, gave "A Wartime View of European Biological Stations" which he illustrated with pictures taken during his recent visit to Europe. A member of the research personnel of the "United Strategic Bombing Survey," Dr. Hasler spent five months overseas and visited personally with Von Frisch, Einsele, Nümann, Elton, Wigglesworth, Schmidt, and Gilson. He told of his visits to various biological laboratories which included the British Fresh Water Biological Station at Lake Windemere, the Bureau of Animal Population at Oxford, the Biological Laboratory at Cam-

bridge, the University of Munich, the Technische Hochschule at Darmstadt, the Reichsanstalt für Fischerei in Austria, and the Institut für Seenforschung on Lake Constance.

Dr. George Urdang, Director of the American Institute of the History of Pharmacy, presented an illustrated lecture on the life and work of the apothecary chemist, "Carl Wilhelm Scheele."

Several lectures and the annual banquet are on the agenda for the next semester's activities.

DR. STANLEY R. AMES

Editor Zeta Chapter.

Alpha Epsilon

—University of Pittsburgh

At the annual initiation and banquet, held at the Ruskin Apartments, the following were initiated: Carsten Ahrens, Martha Bissell, Irene Bocella, Louise Bocella, Thomas Brazelton, Joseph Brevak, Margaret M. Clements, Rosemarie Fiorucci, Artemy A. Horvath, Leonard Laufe, Elizabeth McClelland, Juliet McKibben, Mary Jane Nelan, Walter Shively, Thelma Vonarx.

Mr. Frank Curto, who was a major in the Second World War, has been appointed Horticulturist at Phipps Conservatory, Schenley Park.

Mr. John W. Sumpstine, Professor of Biology at Bethany College, Bethany, West Virginia, died recently, while on a visit to New York City. Mr. Sumpstine was also Mayor of Bethany and was working for his doctorate at the University of Pittsburgh.

At our last meeting Dr. Artemy A. Horvath, Chief of the Pharmacology Department of the Hall Laboratories was the speaker. His topic was "Deproteinization by Metaphosphates." A very interesting subject. Dr. Horvath presented his subject in such a manner,

that even a layman could understand the chemistry involved.

Dr. Kenneth Wertman returned from the Army recently and was appointed Professor of Bacteriology at the University replacing Dr. A. B. Wallgren, who retired last June.

Dr. Peter Gray has been appointed Acting Head of the Biology Department. Dr. O. E. Jennings has been made Emeritus Head and is Acting Director of Carnegie Museum, Pittsburgh, replacing Dr. Andrey Avinoff, who retired on account of ill health.

Dr. Arthur C. Twomey has been made Curator of Ornithology at Carnegie Museum.

Alpha Omicron Chapter

—Marquette University

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Alpha Omicron chapter has a very interesting program for the year. The list of lectures was published in the December issue for this year.

At this point the Editor would like to make an appeal for papers and for information concerning more of the chapters.



Book Reviews—New Books

Except for the signed reviews, the thumbnail sketches of current biological literature appearing in this section are not meant to be exhaustive or deeply critical. They aim to survey the rapidly growing field of biology. Naturally these reviews represent the candid opinions of various readers not necessarily those of the National Council, nor even those of the Editor.

URANIUM AND ATOMIC POWER by JACK DEMENT and H. C. DOKE. *Chemical Publishing Co., Inc. Brooklyn, N. Y. 2nd Ed. 1945 Price \$4.00.*

The underlying principles of atomic power and the atomic bomb are discussed in as simple a manner as possible. The facts are so arranged that the reader gets a clear picture of the structure of the atom. This leads gently into the study of Uranium and the work of the costly cyclotrons. Simpler and cheaper methods are discussed for the release of atomic power. The uranium minerals are discussed. How prospecting is conducted to find uranium minerals as well as the physics of the mineral are described. The importance of uranium has been enhanced by its use in nuclear fission.

Tables and pictures add to the knowledge on isotopes. Nuclear reactions are very useful. A volume full of the newest ideas on atomic physics.

THE STANDARDIZATION OF VOLUMETRIC SOLUTIONS by R. B. BRADSTREET. *2nd Ed. 1944. Chemical Publishing Co., Inc. Brooklyn, N. Y.*

The book is full of important data for analysts, research and other laboratory men. It deals with normal solutions, normality and equivalent weight, effect of temperature and buoyancy error, calibration of volumetric apparatus, acid and base indicators, as well as standard substances for the accurate determination of the concentration of a solution. In addition it gives standard solutions of precipitation reagents. The methods have stood the test of laboratory experience. If you need to get your results in a hurry it is a handy reference. You will also find standard solutions of oxidizing reagents along with tables and logar-

ithms of volumetric factors based on the value of a normal solution. A book to have handy on the shelf for the man who must have results in a short period of time.

HOWELL'S TEXTBOOK OF PHYSIOLOGY, Edited by FULTON. *15th Ed. W. B. Saunders Co., Philadelphia, Pa.*

The textbook has been revised so that the student may realize that physiology is a growing subject. The ideas which have been accepted as facts have to be given up for new facts, which are constantly being shown, or brought to light by research. In order to bring this volume of Howell's work up to date many men in physiology have contributed new chapters or rewritten old ones, so that the very latest information can be included. The work has been primarily for medical students, but really should be considered by majors in zoology, especially interested in specializing in physiology. To help give the student a better understanding, short historical resumes have been introduced on some subjects.

Some of the chapters which have been rewritten or revised deal with the physiology of sex, and summarizing the present status of this branch of experimental medicine. Other chapters discuss muscle and nerve, central nervous system, sensory physiology has been recast in clinical language, physical and protein chemistry of the blood and blood plasma proteins, the cardiovascular system, respiration with the newer concepts of high altitude physiology, water metabolism and the kidney, and basal metabolism has had the part played by endocrines added.

The various authors have attempted to clarify the complexity of the subject. The intricacies of the human body

have been discussed so that the student, who possesses an elementary knowledge of the human body can understand the material presented. A revised text to be recommended to all students of physiology.

THE DIRECTIVENESS OF ORGANIC ACTIVITIES by E. S. RUSSELL *VIII* 196 pp. 23 figs. Cambridge, at the University Press; New York, The Macmillan Company, 1945. \$2.00.

In this small volume of seven chapters, Dr. Russell presents a thesis. Each organism reacts or behaves toward the fulfillment of three ends—development, maintenance, and reproduction of its own specific organization. This fact is illustrated by well known phenomena in morphogenesis, physiology, and animal behavior skillfully abstracted from world literature of biology in such a way that not only is directiveness in organic nature proved but also it is further shown that behavior, morphogenic changes, and physiological responses are functional equivalents in the service of these ends. Directiveness in organisms may or may not be purposive; but consciousness of ends or goals has no necessary part in it. When directiveness becomes self conscious, as in some human behavior, we have, biologically, only a more complex manifestation of the same biological drives—to develop, maintain, and reproduce some specific organization. Discarding mechanism as defeating its own purpose in biology by its overemphasis on analysis and vitalism as vague and speculative, the author pleads for a *biological* approach to living matter. He would have biologists to accept organisms as they find them, as *organized entities* with characteristics peculiar to such organization, and to study biology on this plane. Only in this way can biology, as biology, advance without becoming increasingly subservient to and dependent upon physics, chemistry, and mathematics. Biology, in following the philosophy of mechanism, defeats its own purpose, since biological entities always start with complex organization, which to analyze too fully is to destroy.

Dr. Russell has done a great service in emphasizing the sterility of mechanism for biological science; but I have one question. Does he mean that biologists shall be limited to the biological

plane? If so, I cannot follow his leadership. To me science must be free to follow any lead. Physical and chemical means to biological ends are justified, provided these ends, as biological ends, be not forgotten. I think, however, that Dr. Russell does not mean this; but rather, that biologists have used the mechanistic approach so long that many of them have forgotten that they are students of life and that life is manifested *only* in complex organized form. If so, then I go all the way with him. Life and living will never be "explained" *merely* by examining extracts in test tubes, studying enzymes and hormones, viscosity of gels, permeability of membranes, etc. Life occurs only in organization; and its explanation, if ever found, will be wholly or in part, in terms of organization.

ARTHUR N. BRAGG.

PRINCIPLES OF MODERN BIOLOGY by DOUGLAS MARSTAND and CHARLES R. PLUNKETT, *IX*, 774 pp. 350 figs. Henry Holt and Co., N.Y.C. \$3.75.

This revision of Plunkett's **ELEMENTS OF MODERN BIOLOGY** by Dr. Marstand retains the essential viewpoint of the older book but is a reconstruction of it utilizing the newer knowledge of physiological principles, both in the adult and in the embryo. Anatomy, both as to details and as to principles, is largely omitted on the viewpoint that its study belongs to the laboratory. Man predominates in the emphasis in order to catch student interest. Plants, especially in reproduction and in their broad relations to the nutrition of animals are discussed adequately; but more space is given to animals than to plants. Heredity is given one chapter, organic evolution, two; and the remainder of the book is largely physiology. The whole is dominated by the physiological and experimental viewpoints. Taxonomy as such is largely omitted except for a list of the major groups given as an appendix. There is an adequate index and an exceptionally good glossary.

The language used is clear and the choice of words especially good. Perhaps the style is too heavy for the average college freshman; and a student will find an elementary knowledge of chemistry and of the physics of liquids necessary to the fullest use of this text. Exceptionally good "test questions" at

the ends of chapters bring out interrelationships and principles instead of mere facts.

This is a very fine text for a well prepared student who wishes a presentation of the physiological principles of the organic body. Its one essential weakness is that its title and viewpoint imply that modern biology is essentially physiological. Ecological and taxonomic principles as well as those of distribution of organisms, and habits and other behavior of animals are integral parts of modern biology; but to read this book one would never suspect it. It appears to me to be unsound to offer *any* one viewpoint as the whole or the principal one of modern biology, especially to immature minds.

AN INTRODUCTION TO HUMAN ANATOMY by MARSHALL and LAZIER, 3rd Ed. W. B. Saunders, Philadelphia 1946. \$2.50.

This third edition of Marshall's **INTRODUCTION TO HUMAN ANATOMY** by Lazier has been improved by reorganization of the material. Material and illustrations have been added. In some instances labels have been added to the drawings. This alone is of great value to the beginner in the study of anatomy. Sometimes when looking at the pictures of bones, especially from a new angle the student becomes confused if the pictures are not labeled. He is not well enough acquainted with the objects to be sure he is seeing the same bone from another side. Hence the labeling will aid in clarifying this confusion. The improvement in the text should be welcomed by all teachers of anatomy. The original purpose of the first edition has been maintained throughout.

ELEMENTARY BACTERIOLOGY by J. E. GREAVES and E. O. GREAVES, 5th Ed. W. B. Saunders Co., Philadelphia. 1946.

The revision has been made with the idea of presenting the most recent advancements in the field of bacteriology. The study of pure cultures and the advancement made in the study of diseases and their cause has shown that antibiotics must be included in any study of bacteriology. The material has been rewritten and much of the old material has been replaced by new on some of the following subjects: elec-

tron microscope; penicillin; the development of antiseptic surgery; the advancements made in viruses; influenza; typhus fever; and Rocky Mountain spotted fever. The work of Walter Hesse and his wife has been added.

The student will also find information on the new problems of water purification which arose as the result of the war. Material has been added on bacterial desiccation as well as some on the intestinal microflora.

The questions at the end of the chapters are designed to make sure the important topics of the chapter have been understood.

GENERAL BIOLOGY AND PHILOSOPHY OF THE ORGANISM by FRANK S. LILLIE. 215 pp., University of Chicago Press, 1945. \$3.00.

Most philosophers and scientists say that either the universe is completely under the control of physical law or it *isn't*. They have been debating the pros and cons of this question for many years and some have tried to find a compromise where, to others, it seems that none can exist. Dr. Lillie, an eminent physiologist at the University of Chicago, is one modern scientist who says that blind physical law is not enough.

Frankly recognizing teleology, purposiveness, directiveness, and goals as parts of organic nature, he sets out to demonstrate in this book that organisms are not merely physical (physiochemical) entities but *psycho*physical ones. He sees the physical as the staple, conservative, and therefore predictable factors in natural phenomena; and the physical as the progressive, creative, and therefore unpredictable factors. Both are present in all organisms, the physical continuously operating, the psychical only intermittently. Drawing heavily upon human mind, body and experience for illustration (because here can the psychic be studied most easily) he shows the basic unity of the whole being and its directive potential which he takes to be the result of an intimate and integrated interrelation between the ever present physical, steered and directed toward goals by the intermittently interfering psychical. By analogy and on the assumption derived from organic evolution that all life is related, he attempts to show that other organisms

are like man in their basic aspects, differing only in degree, not in kind.

One's reaction to this book is almost certain to be colored by previously held ideas. Mechanists can not accept it and still remain mechanists, but they will be forced to answer its arguments. Vitalists will probably hail it as an exceptionally able justification for their faith. Religious leaders of all faiths will favor it as an example of the thought of one universally recognized scientist who leaves at least a place for Deity in the universe. But some will not like its clear cut statement that the psychic factors in life apply generally rather than to man alone because, if this be true, their theologies will need some patching.

Agnostics will ask two questions: Can we be *certain* that all other organisms differ psychically from man only in degree? Many able philosophers and psychologists have taught otherwise. This is the weakest point in Dr. Lillie's very strong argument,

for he makes assumptions here which, while biologically quite reasonable, need *absolute* proof because of their fundamental importance to the basic question at issue. They will ask also, what is the nature of the psychic factor? Dr. Lillie does not tell us. He rightly says that this is a metaphysical problem; because the psychic can not be directly observed and measured if it is outside the province and methods of science. The author here is not led into speculations for which no real proof exists and this is to his great credit as a thinker and scientist. Nevertheless, one cannot be completely satisfied with a philosophy which cannot account for a basic factor in life.

I consider this book the best presentation of vitalism which I have seen. It is also one of the most unifying and thoughtful volumes published by a biologist in this generation. It is highly recommended to mature readers of whatever philosophic views.

ARTHUR N. BRAGG.



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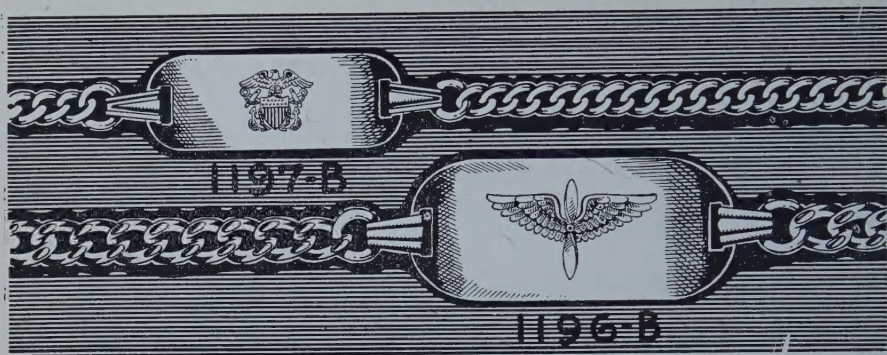
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